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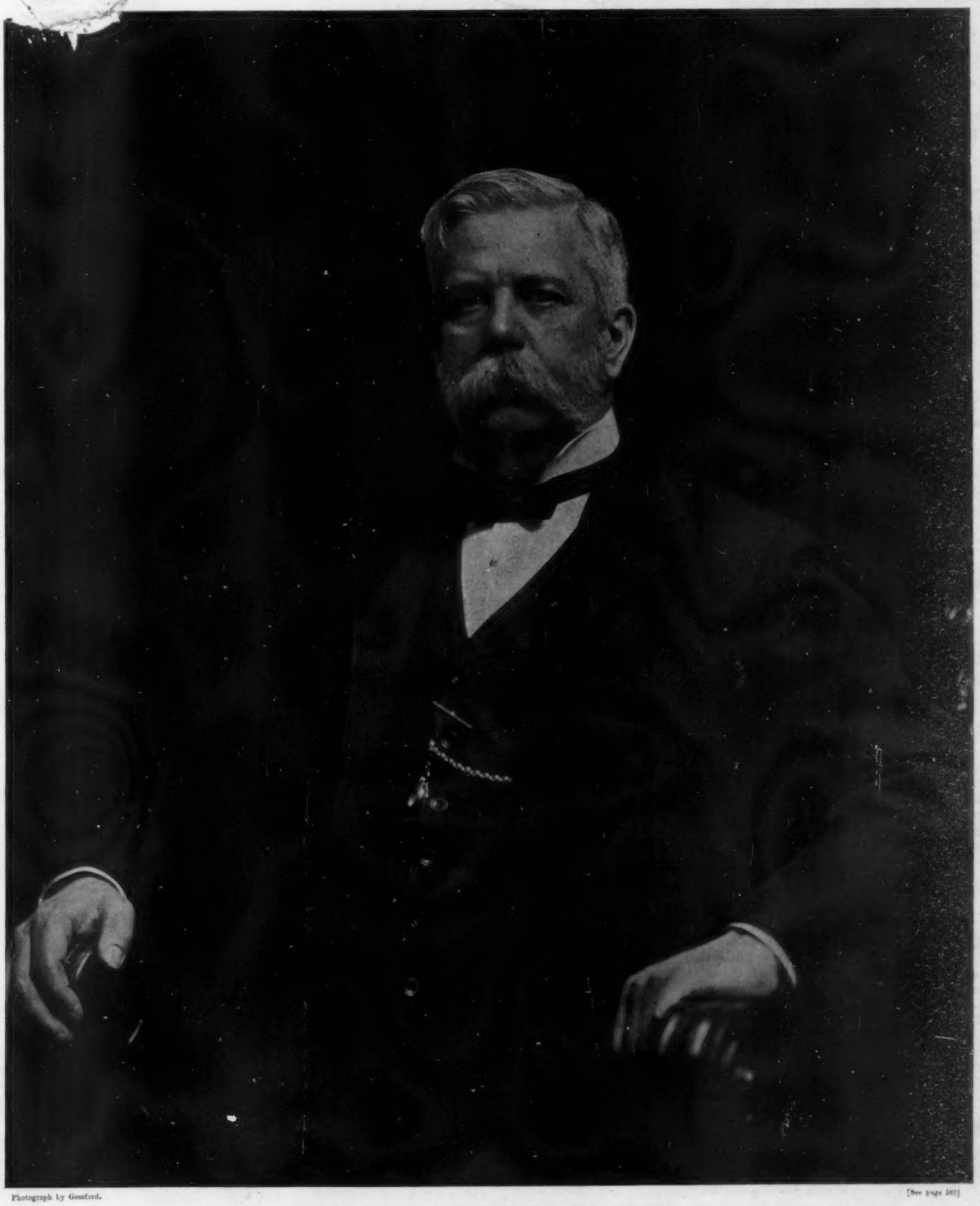

Photograph by Gessford.

[See page 592]

GEORGE WESTINGHOUSE, ENGINEER AND INVENTOR

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Battle-cruisers for the United States Navy

THE recent visit of the German battle-cruiser "Moltke" must have raised the question in the minds of many people, as to why the United States navy possesses no vessel of this type. Great Britain, Germany and Japan, the three most powerful and progressive among our competitors in naval construction, are committed to the policy of building ships of the battle-cruiser type in considerable numbers. Great Britain has seven either completed or in course of construction; Germany has five, and Japan four. The United States possesses none of these formidable vessels, nor has any appropriation been requested for their construction.

This neglect of an important type of war vessel is not due to any want of appreciation of its excellent qualities on the part of our Navy Department, but rather to a conviction that the most important element in the make-up of our navy is an adequate force of heavily armed and armored battleships, capable of lying in the first line of battle and opposing heavy gun with heavy gun and heavy armor with heavy armor. Consequently, the greater part of the appropriations made by Congress for several years past have been devoted to the building of battleships of the greatest size, power and defensive qualities.

At the same time it cannot be denied that the battle-cruisers have so greatly increased both the gun power and armor protection, that they have reached a stage which makes it a question whether these exceedingly fast ships would not be capable of taking their place in line with the battleships and fighting it out to the end in a general fleet engagement. If they can do this, their high speed of from twenty-eight to thirty knots certainly places them at a great advantage over the twenty-one-knot battleship. The old argument against the battle-cruiser on the ground of its light armor protection and relatively feeble battery has lost its force. The British "Lion" with its 9-inch belt and eight 13.5-inch guns; the German "Moltke" with its ten 50-caliber, 11-inch guns and a belt probably not less than 8 or 9 inches in thickness; the Japanese "Kongo," with its battery of eight 14-inch guns and an armor belt probably of the same thickness as that on the "Lion," are vessels which would not hesitate to lie in the first line, should an emergency call for them. They could severely punish the enemy in the first few minutes of the fight, and, by choosing a long range, they would be able to stand up against the attack of the 12-inch guns which are in such a great majority among the battleships of the present day. The distinguishing feature of the battle-cruiser, however, is its exceedingly high speed. The "Moltke" has maintained an average speed of twenty-nine knots for several hours on the high seas, and the "Lion" is credited with having made over thirty knots under the same conditions. The Japanese "Kongo" is required to make twenty-eight knots to fulfill the contract, which means that she will make from twenty-nine to thirty knots with her improved turbines.

Now remembering that the battle-cruiser can put up a very hard fight if she is pushed to it, let us see what advantage she acquires from her extreme speed. In the first place, like the fast sailing-frigate of early days, she has the weather gage of her enemy. That is to say, she can place herself at whatever distance best suits her battery and armor as compared with those of the enemy. If she wishes to fight a long-range engagement, she can do so. Should she wish to close in, she can by virtue of her high speed put herself at any distance she may choose from her slower opponents. Acting as a scout, she can steam at high speed through the outer screen of the enemy's scouts, and venture in sufficiently close to his main line of battleships to take accurate account of his numbers and strength.

It must be remembered, also, that lack of speed is one of the most frequent of the deficiencies which render a warship obsolete. She falls behind in speed sooner than in gun-power or protection. The battle-cruiser, because of its high speed, will be available for the effective list long after the contemporaneous battleships have been relegated to the second line.

In a fleet engagement, moreover, a squadron, say of four battle-cruisers of twenty-eight to thirty knots speed, might lie to leeward of their own battleship line, and then, at the critical moment, steam ahead, swing across the enemy's line and pour upon his leading ship the concentrated fire of over forty guns of the greatest power. Both the moral and the practical effect of such a maneuver would be enormous. The demoralizing effect of such an attack would be greatly heightened if the four cruisers, as they swept across the head of the enemy's line, were to discharge their torpedoes at such an acute angle to the enemy's line that they could scarcely get through without striking one or more ships in the long-drawn-out line.

It will, of course, be urged that in the case of our navy, appropriations come with such difficulty and with such a sparing hand, that we cannot afford to drop below our two-battleships-a-year standard; that if we build one armored cruiser, it means one battleship the less. This is perfectly true, and yet we cannot but feel that the sacrifice should be made. Our navy should make an early start in the construction of one of these ships, if only for the experience that would be gained. There seems to be little doubt that the battle-cruiser has come to stay, at least for a term of several years; and it is quite conceivable that the total lack of such ships by our navy might prove to be a serious handicap in some future naval war.

Emergency Cars for Stranded Motorists

WHILE the modern motor car may be said to have passed the stage in its development in which it was necessary to be continuously prepared for a breakdown, there still are times when such breakdowns do happen—and usually at the most inconvenient time and place. On any fine day, frequenters of the main traveled arteries of motor traffic in Greater New York may find cars broken down, with "blown-out" tires, leaking or empty gasoline tanks and similar troubles of the kind which are likely to happen to most automobile owners and drivers. On such occasions the temper of the driver and passengers is sorely tried—not so much by the pecuniary loss caused by the accident, but the sarcastic looks and remarks of passing folk. It is not an easy thing by any means to fit a new tire "shoe" to a rusty felloe, or to make a repair of a puncture on the open road, without in some way appearing "funny" to the onlooker. Add to that the dirt, dust and hard work accompanying the repair work, and one can easily understand the discomfiture of the average motorist when a puncture seems imminent.

What would he not be willing to pay for having such minor road repairs made on the spot, without soiling his clothes and fracturing his temper? A couple of dollars would seem a small sum, and surely there is money in the idea for an enterprising garage owner. Why not use two or three of the oldest cars in the garage as "trouble cars"—such as the railroads employ in their service? Why not dispatch these cars along the main traveled roads, where they would drive at slow speed, looking for cars which have met with an accident or which are afflicted with the "strike" habit and refuse to run, despite all the distracted owner can devise or attempt. A few deft touches from "one who knows" may straighten the matter out in a minute, save the motorist a peck of trouble and expense, and make his trip agreeable instead of a failure.

Carrying the suggestion still further—why should not cars loaded with various makes of tires, of the most common sizes, be sent out on such cruising expeditions? Financially, the scheme should prove attractive; and if it were worked *honestly—bona fide* sales being made at regular store prices, and the damaged tires being taken in part payment—it would prove to be popular. Buccaneer methods, of course, would spoil the entire plan; the work must be done with the idea of increasing trade and giving full value for each dollar. Many a motorist goes on a trip supplied with money, but short of tires; and when he does get into trouble, he too often finds himself miles away from the nearest garage and tire sales room. The cruising tire wagon and automobile repair car would remove one more of the serious drawbacks which have spoiled many an otherwise successful automobile trip.

The Contest Committee Which Will Award the Gould-Scientific American Prize

ACCORDING to the rules governing the competition for the Gould-SCIENTIFIC AMERICAN $15,000 flying machine prize, "for the most perfect and practicable heavier-than-air flying machine designed and demonstrated in this country and equipped with two or more complete power plants (separate motors and propellers), so connected that any power plant may be operated independently, or that they may be used together, the machines entered must be tried out in the presence of a Contest Committee consisting of a representative of the SCIENTIFIC AMERICAN, a representative of the Aero Club of America, and the representative of some technical institute," the following committee has been appointed:

Mr. Charles M. Manly, representing the Aero Club of America.

Major Samuel Reber, U. S. A., representing the United States Military Academy of West Point.

Mr. J. Bernard Walker, Editor of the SCIENTIFIC AMERICAN, representing the SCIENTIFIC AMERICAN.

It would be difficult to find a committee of men in this country better able to pass upon the niceties of flying machine construction than that which has been appointed. As the prize is to be awarded for a type of machine which is to be so safe, that, if widely introduced it will make flying more popular, it was felt that only men who are technically informed and who are keenly alive to the dangers of flying should be entrusted with the responsibility of deciding which machine is the winner.

Mr. Manly, who will represent the Aero Club of America, was at one time an assistant of the late Prof. Samuel Pierpont Langley. It was he who was responsible for the wonderfully light and efficient engine which was constructed for Langley's man-carrying flying machine, after fruitless attempts had been made to obtain a suitable motor from builders in this country and in Europe. Mr. Manly was also the pilot who sat in the seat of the man-carrying machine of Langley when it came to grief in the Potomac River because of a defective launching apparatus. Inasmuch as motors will play perhaps the chief part in the contest for the Gould-SCIENTIFIC AMERICAN Prize, it was felt that at least one member of the committee should have considerable experience as a designer and builder of motors. That experience Mr. Manly undoubtedly has had.

Major Reber is a member of the Signal Corps and, therefore, necessarily conversant with the development and uses of the flying machine. There can be little doubt that the two-motor machine will sooner or later be adopted for military purposes. A military air scout must be able, not only to gather the information for which he has been sent out, but also to return with it. Nothing could be more ignominious than a compulsory descent into an enemy's camp because a motor has failed. While the prize is not offered to a specifically military machine, there can be no doubt that the War Department will profit by the contest and by the presence on the committee of a distinguished officer of the Signal Corps.

Mr. Walker needs no introduction to the readers of the SCIENTIFIC AMERICAN. He is a strong advocate of the reduction of head resistance in the aeroplane; and it is interesting to note that the racing monoplane, with its inclosed body, small running-gear, and a few guy-wires, is following the lines laid down in his "Study of the Racing Aeroplane of the Future," in the SCIENTIFIC AMERICAN of October 22nd, 1910.

The Contest will begin at 10 o'clock on the morning of July 4th, on the Hempstead Plains Aviation Field. The demonstrators of the machines will be asked to prove conclusively, both by ground and air tests, that, in accordance with the rules, they can run their motors independently or together. In judging the relative merits of machines whose performances are equally good, the judges will take into consideration general design, care of construction, and above all, safety.

The Committee is engaged in planning the tests to which machines will be subjected and in devising a point system which will take into consideration both the performances of motors and the general design of machines.

Engineering

Suez Tolls and the Panama Canal.—The total receipts for the year ending June 1st, from tolls through the Suez canal were $27,762,000, which is $866,000 in excess of the tolls for 1911. The Suez Canal Company announces that this increase had led them to make a reduction in the tariff on vessels passing through, which will be in force on January 1st, 1913. It is reasonable to suppose that the motive for this reduction is to be found in the near approach of the opening of the Panama canal.

Bilge Keels on Battleships.—The British battleships "Orion" and "Monarch," the first of the super-dreadnoughts to carry 13.5-inch guns, rolled heavily, a very serious matter for the gun-pointers. It is stated that on one occasion the "Orion" rolled as much as twenty-one degrees from the vertical. The defect is being remedied by removing the narrow bilge keels with which these ships were fitted, and substituting others of much greater depth.

Programme of Russian Naval Construction.—The Russian Naval Programme of Construction contemplates the construction of four armored cruisers, to steam at the rate of 27 knots, four smaller cruisers to displace 8,000 tons each, 46 torpedo boats of 35 to 36 knots speed, and a dozen submarines. The work of construction is to be spread over six years, ending with the year 1917. The most interesting of the ships are the armored cruisers, which doubtless will be of about the same size and power as the new Japanese cruisers.

Maritime Canals and Vessels of the Largest Size.—C. E. Grunsky in his report to the International Congress of Navigation concludes: That a limit should be set on the draught of sea-going vessels; that government aid should not be extended to the building or operation of sea-going vessels with a draught exceeding 32.2 feet; and that the maximum dimensions of sea-going vessels, built or operated under government subvention, should be fixed by international agreement along the following suggested dimensions: Length over all, 900 feet; breadth, 105 feet; draught, 32.2 feet.

Gas Buoys in the Lighthouse Service.—According to the Commissioner of Lighthouses, G. R. Putnam, the United States Lighthouse Service maintains at present 287 lighted buoys, the major part being Pintsch gas buoys, and the remainder three different types of acetylene gas buoys. Different systems are used according to local conditions. The great advantage of the gas buoy is that it may be placed in locations where it would be difficult to maintain either light vessels or lighthouses, compared with which the original expense of installation and maintenance of the gas buoy is small.

The Revival of Ship Building in the United States.—We are pleased to note that our contemporary, *International Marine Engineering*, is of the opinion that there is a decided revival of ship building in the United States. Since the first of the year orders have been placed with United States shipbuilders for over 110 steamships of various kinds. With one exception these are all for coast line trade. One steamship company has placed orders for 80,000 tons of shipping during the last six months, an order which has never so far been equaled in the American shipping industry.

The Welland Canal to be Widened and Deepened.—The Canadian Government has decided to both widen and deepen the Welland canal from Port Colborne to a short distance north of Thorold. The canal will be deepened from 14 to 25 feet and 30 feet in the locks, and it will be widened from 150 to 200 feet. A new section of similar dimensions is to be cut for a distance of 5 miles from Thorold to Lake Ontario at Ten Mile Creek. This reconstruction will make possible the reduction of the number of locks from 22 to 7. Eight hours will be saved between Port Colborne and Fort Dalhousie. The total estimated cost of the new work is $45,000,000.

Reinforced Concrete in Hydraulic Works.—In his report to the Twelfth International Congress of Navigation, at Philadelphia, J. S. Sewell states that a few years ago difficulty was sometimes experienced in securing a Portland cement that was sound and secure against disintegration due to the chemical changes within itself after setting. This difficulty is now easily avoided, and if aggregates are selected of durable and inert materials, there can no longer be any doubt that concrete in itself is a perfectly durable material, quite secure against disintegration due to action originating within the mass itself.

New Japanese Battle-cruisers.—By the launch last month of the armored cruiser "Kongo," which is being constructed at the Vickers yard, England, for the Japanese navy, the Japanese possess, for the time being, the largest and most powerful warship. Strictly speaking, this new vessel is a battle-cruiser, in which class she belongs by virtue of her high speed of 28 knots and her powerful battery of eight 14-inch guns. The ship is 704 feet long, 92 feet beam, and about 27,500 tons displacement. Her fuel capacity is enormous, consisting of 4,000 tons of coal and 1,000 tons of oil fuel. In addition to her 14-inch guns she carries a powerful battery of sixteen 50-caliber, 6-inch guns mounted on the main deck.

Electricity

Molten Glass as a Conductor in the Electric Furnace.—A new form of electric furnace for the melting of dross, scrap metal and cyanide precipitates utilizes the arc at the start and afterward the electric conductivity of melted glass to maintain the action. On beginning the melting the furnace is partly filled with broken glass and the carbon electrodes adjusted into contact and then drawn apart, forming an arc. As the glass melts it becomes conducting, and the carbons are drawn farther apart until the entire mass is molten. The dross, etc., is then charged into the furnace, and is melted by the initial heat of the glass. Owing to its higher specific gravity the melted metal falls to the bottom, where it is protected from oxidation.

Electrically-produced "Cold" for Making Ice Cream.—The ordinary method of freezing ice cream by ice and salt is a striking example of economic waste. Every 100 gallons of ice cream requires a ton and a half of ice and 800 pounds of salt; and the salt is not recovered and the ice melts very rapidly. Electricity is now conserving these materials by producing artificial refrigeration and applying it to the manufacture of ice cream. Electric motor drive is used to turn the freezers. Statistics show that in the five years from 1906 to 1910 the consumption of ice cream in the United States advanced from 55,000,000 gallons to 100,000,000 gallons. Last year about 120,000,000 gallons of this delicacy was eaten by Americans—an average of five quarts per capita.

Electric Railway Signals Employing Lights Only.—Economy in first cost and in maintenance is leading a number of electric interurban railways to adopt automatic block signal equipments in which semaphore mechanism is done away with and entire dependence placed on incandescent lamps, by day as well as by night. Metallic filament lamps are used, placed behind large red and green lenses, and the entire outfit is mounted in a sunbonnet-shaped hood to enable the lights to be seen by day. With only the light indications, no motor-driven mechanism is required. Experiments on the arrestiveness of these signals show that they can be seen plainly 1,500 feet on a bright day from a car moving at about 40 miles per hour. It is necessary to guard against phantom signals given by reflections from the headlight of the approaching car.

An Electric Motor for Under-water Operation.—In the early days of electrical engineering the escape of current by moisture on the insulation of line or apparatus was a bugbear. Nowadays electrical apparatus is designed to be proof against the weather, mud, corrosive fumes, and other severe conditions; but at the present stage of electrical engineering only certain types of alternating current apparatus free from commutators, collector-rings or other exposed conductors are capable of operation when submerged in water. A spectacular test was made recently of a "submersible" squirrel-cage motor wound with rubber-covered conductors and with channels for the circulation of water through the rotor and the stator. The motor was direct coupled to a centrifugal pump, and the test consisted in pumping out a barge which was sunk into the river up to its gunwale—an operation requiring thirty minutes.

Determining the Effect of Weather Conditions on Transmission Lines.—"Line breaks" on pole lines of telegraph, telephone, and electric light and power systems have caused immense expense from the damage inflicted by winter winds when ice had formed on the wires and "built them up" to such abnormal size as to develop a high side-pressure from the wind. In many instances blizzards have crippled pole lines for long distances, resulting in heavy loss to the operating companies from the interruption to the service and the cost of emergency and permanent repairs. The department of electrical engineering at the Massachusetts Institute of Technology has had erected in Brookline, Mass., a 700-foot span of No. 00 bare stranded wire to represent a transmission line on tower supports, and has had this span under observation during the severe weather of last winter to determine more exactly the effects of the stresses on the wire and its supports of ice, sleet, wind pressure, and temperature.

Prof. Kapp's Invention for Improving Power Factor.—The ability of an ordinary condenser of the tinfoil and dielectric type to produce a "leading current" in alternating current circuits and thus improve the power factor has long been known, and has been utilized in dealing with high voltages and frequencies. But at the low voltages and frequencies of ordinary commercial electrical apparatus the size and therefore the cost of a condenser would be prohibitively high. Prof. Gisbert Kapp has now come forward with an entirely new type of dynamo-electric condenser, which he calls a "vibrator." This machine advances the phase of an alternating current by injecting into the latter a suitable electromotive force. In the operation of the machine, during the "charge" in each cycle of alternation the electrical energy is converted into the kinetic energy of a rotating mass, and during the following "discharge" the energy is given back as electric current at the pressure of supply.

Science

The International Polar Commission will convene in Rome during the meeting of the Tenth International Geographical Congress, on April 2nd, 1913.

Filtering of Very Fine Precipitates Suspended in Liquid.—Grind down in a mortar shreds of filter paper and then mix with plenty of water. Allow the coarser fibers to settle, then add the turbid water to the filter. Very fine precipitates, such as mercury sulphide, may thus be filtered.

The Crocker Land Expedition has been postponed to the summer of 1913, on account of the death, by drowning, of George Borup, who was to have led the expedition jointly with D. B. MacMillan. A substitute for the dead explorer has not yet been chosen.

The Bacillus of the Foot and Mouth Disease in Cattle.—It is announced in the daily press that Prof. Wilhelm Grugel, Dean of the Hygienic Institute of the University of Rostock, has not only found the bacillus which causes foot and mouth disease in cattle, but has also found a serum for immunizing cattle against the malady. The serum is said to be not curative but preventive, and can therefore be administered only to healthy animals. Further details will be awaited with interest.

The Divining Rod as a Detector of Hidden Water.—The phenomena supposed to be exhibited by the divining rod (Wünschelrute) has now been seriously tested in German Southwest Africa, where something like 800 experiments were made with it in search of water, about 80 per cent of these being successful. It has also been used with success in Hanover to indicate the presence or otherwise of veins of salts of potash in the soil. The Minister of Agriculture in France has appointed a departmental committee to make similar experiments.

International Congress on Hydrology.—Information has been transmitted to this Government through the customary diplomatic channels, that the International Congress on Hydrology, Climatology and Geology, originally appointed to be held at Madrid, October 15th to 27th of the present year, has been postponed to the same dates (October 15th to 27th), 1913. The participation of American scientists, scientific associations, and higher institutions is solicited by the Organizing Committee.

A Fixed Date for Easter.—At the fifty-second annual meeting of the Association of Chambers of Commerce of the United Kingdom, held in London last March, it was agreed unanimously that a fixed date for Easter ought to be adopted by international agreement. This is a rather startling illustration of the freedom of thought that characterizes the twentieth century. Throughout the middle ages Christendom was rent with continual discussions as to the correct method of adjusting the occurrence of Easter to the phases of the moon, and the simple expedient of adopting a fixed date for the festival would have been regarded as an audacious piece of impiety.

New Chinese Coinage.—The provisional government of Canton is issuing the new 20-cent pieces for which provision was made some time ago. The coins are the first to be issued under the new government in China, and instead of the well-known dragon design, the coin bears on one side Chinese characters for "Republic of China, first year, Kwangtung Province." On the other side are the words "Kwangtung Province, Twenty cents," in English. (Consular Report.) The new Chinese Republic dollars, a sample coin of which has been approved by Yuan Shih-kei, will bear two lions and the Chinese characters for "One Dollar" on one side, and on the reverse the characters "Current Money," "Chinese Republic," with a wreath of flowers.

Astronomy and Meteorology in South Africa.—We recently announced the amalgamation of the provincial meteorological services of South Africa into a single service for the whole Union, with headquarters at Pretoria. A circular from Prof. R. T. A. Innes, in charge of the observatory at Johannesburg, indicates that there has been an analogous centralization of the astronomical work. The institution at Johannesburg is now known as the "Union Observatory" and will hereafter devote its attention chiefly to astronomy. Its director, Prof. Innes, has been appointed "Union Astronomer" for the whole of South Africa. The Natal Observatory at Durban has been closed, and the Cape Meteorological Commission dissolved.

A New Form of Dark Radiation.—A new form of dark radiation seems to have been discovered by Prof. A. Remele, who has been experimenting for some years with nitrate of boron. He has found that this substance gives off at ordinary temperature radiations which will influence a photographic plate through several thicknesses of black paper, leather, India rubber and glass, and the images obtained strongly resemble those given by the X-rays. The radiations are completely absorbed by metals. Electroscopic examination shows that nitrate of boron—like nitrate of uranium—emits electrons, or negative particles, and it is suggested that this points to some connection of nitrogen with radio-active phenomena hitherto unsuspected. It is certainly curious that, up to the present, radio-activity has generally manifested itself in the presence of salts.

A Journey in a Passenger-carrying Zeppelin Airship

The Fascination of a Trip Through the Air

By Carl Dienstbach

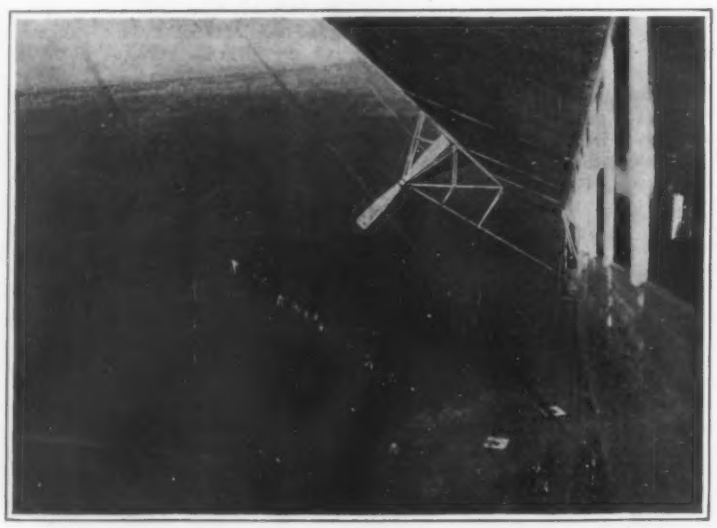
YOU can buy an airship ticket, good for a trip in a Zeppelin, in almost any large American city now, for the Zeppelins sail almost with the regularity of steamers. With your ticket in your pocket you eventually reach Frankfort with the intention of using it. Long before you step on board the airship you will be reminded of its existence in more ways than one. You may see three men busy with a round object of a very conspicuous reddish brown. Closer inspection proves it to be a balloon, which in spite of its moderate size can easily be seen at a great distance. As it drifts off one of the men watches it for a long time through from what seemed to be a telescope on a tripod, but which is in reality a theodolite.

To the uninitiated tourist, this seems like a marvelous waste of time. The meaning of it all dawns on him when he wends his way to the airship office. In the window he sees a printed weather report. It consists of a weather-map and two columns of news and meteorological forecast. The bulletin is not unlike other weather bulletins all over the world, but in a separate column on the left is a space devoted to "Aeronautical News." In the column of aeronautical news you read that "the wind at 300 meters altitude is blowing east with a velocity of 6 meters a second; at 600 meters, southeast by east with a velocity of 8 meters a second; at 900 meters, southeast with a velocity of 9 meters a second." You are also assured that "No thunder storms are imminent." In the office itself are displayed pictures of the "Schwaben," the "Victoria Luise," and "Hansa" plowing the air over the secluded valleys of the Black Forest, hovering over the mythical seat of the Loreley, and speeding over the surf of the North Sea. Then you proceed to the desk and present the ticket that you bought in New York. To the usual tourists' questions unusual answers are given.

"We expect to have the 'Schwaben' sail for Duesseldorf early to-morrow morning," the clerk behind the desk tells you, "but the second weather reports have not arrived yet. If the upper wind has not shifted south by to-night, she will have to go to Heidelberg instead, leaving at 10 A. M. and returning without landing." The trip to Duesseldorf, you learn, is somewhat more expensive, which is the only soothing factor in the uncertainty. "Just a moment," says the clerk, "I'll call up the Physical Society." That explains the meaning of the three men and the balloon on the top of that building. Whether or not you will be able to journey through the air to Duesseldorf depends upon the report of those three men. In a moment the clerk returns. "All right," he says, "the 'Schwaben' will sail up the Rhine." You learn that the vessel will ascend punctually at 6 A. M., and that she is due at Duesseldorf before noon. You must embark by 5:30. The clerk tells you to have your luggage forwarded immediately to Duesseldorf, for it takes the train eight hours—longer than the airship—to make the journey. Why not carry it on the airship? Heavy hand baggage is charged for extra, for it consumes as much space as an additional passenger. Light hand baggage, satchels, overcoats, cameras and the like are, of course, carried free. You ask about clothes. "Is it necessary to wear a heavy overcoat?" "No," answers the clerk. "A light one will do. If the airship rises as high as 2,000 feet, the air becomes perceptibly cooler. There is no side wind. Plunging on at the rate of forty miles an hour, the airship always seems to be sailing straight into the teeth of the wind," the clerk tells you. "If you open the window, you get just enough breeze to make you feel comfortable in the sun." He advises you to take a broad-brimmed straw hat rather than a steamer cap, for the sun even at a height of only one hundred meters is very warm. The officers, you learn, wear the regulation marine uniform, including the peaked cap, for they are often exposed to the full force of the wind, and sometimes to stinging rain and even hail. The clerk finally assigns your seat to you. You find that you are the last one of a full complement of twenty-four passengers.

Sending up a pilot balloon. By means of the theodolite, the balloon is followed until it is lost to view. Thus the direction and velocity of the wind are ascertained. Similar observations are taken from the top of the building of the Physical Society in Frankfort.

A Zeppelin airship leaving its shed.



When the airship starts and lands, a company of men pull upon the guide ropes and hold it in proper position.

Long before sunrise the next morning, the great airship shed is aglow with electric lights. Gas hose extending from wells in the cemented floor are shifted from one gas cell to the other. The water-ballast bags are likewise filled. So too the trimming tanks. To see whether the tanks are really in good form, whether they are able to trim the ship, a brief test is made, accompanied by much splashing of water. If the tourist should happen to come to the shed ahead of time, he will find the entire floor thoroughly wet. A hand truck, on which steel barrels of gasoline are carried, is pushed into the shed. It stops first at the rear car. A metal-covered hose is placed in position and several men busy themselves with a pump. When the gasoline tanks of the rear engine room have drunk their fill, the same operation is repeated at the forward car.

Hardly has the gasoline truck been wheeled away, when a thunderous roar echoes through the shed. The rear motors are being tested. Everything seems to shake. When the din at last ceases, daylight streams in through the windows and dims the electric glare. Through a little door, set into one of the gigantic portals of the airship shed (portals which it takes ten electric horse-power to open), enters the captain, a tall, powerfully built man with a long blond beard. He is followed by two fashionably dressed ladies, obviously the first passengers to arrive. It is difficult to believe that this is not the seaport of Cuxhaven, but the great airport of Frankfort. Soon other passengers arrive, as well as officers—one a wireless operator. Presently a door in the side of the car is opened and an "able airman" lowers a slender flight of aluminium steps. At the foot of this gangway the solitary steward of the ship takes his position. He finds it no very difficult task to minister single-handed to the wants of twenty-four passengers.

Another squad of men appears. They are not members of the crew; yet they belong to the ship. It is their duty to move the vessel out of the shed and over

(Concluded on page 591.)

The Galveston Causeway

A City Made Impregnable Against the Assaults of the Sea.

By Meigs O. Frost

THE recently completed $2,000,000 Galveston causeway, a structure of earth, steel and concrete that crosses a two-mile stretch of Galveston Bay and joins Galveston Island to the mainland of Texas, marks the culmination of Galveston's twelve-year campaign to make the city impregnable to the assaults of the Gulf of Mexico. In the course of that campaign, the city of 40,000 people, aided by the farmers of Galveston County and the railroads comprising the Galveston terminal lines in the construction of the causeway only, has built a concrete sea wall five miles long and seventeen feet high, forming a rampart against the waves of the gulf; has raised the grade of the city seventeen feet to place the streets and houses flush with the crest of the sea wall, pumping in nearly 20,000,000 cubic yards of sand from the bed of the ocean; and lastly, has joined the island to the mainland by one of the greatest and most massive structures known to the history of concrete engineering. A raised boulevard from the heart of Galveston to the island end of the causeway provides entrance and exit at all hours to and from the second largest port in the United States (ranking next to New York) and the greatest cotton port in the world.

The last of the trinity of protective engineering works that have cost Galveston nearly $10,000,000 contains many unusual features. The roller lift bridge that opens a 100-foot passage for ocean liners is the largest bascule bridge in the world. With the safety interlocking device it cost $97,400. The complete block signal system insuring safety in the operation of trains across the causeway is the best and most modern in the Southeast. Installed under the personal supervision of railway officials, it cost $80,000. Into the two-mile structure went 2,620 tons of reinforced metal, 625 tons of tie rods, 74,400 cubic yards of concrete, 806,600 cubic yards of filling, 172,081 linear feet of concrete piling, 246,820 linear feet of wooden piling for foundations, 60,000 cubic yards of gravel, 30,000 cubic yards of sand and 81,500 barrels of cement.

The end to end length of the causeway is 12,642 feet—a trifle under 2 2/5 miles. Of this length 10,170 feet is taken up by the roadway protected by concrete piling and concrete slabs. The arch-bridge portion, which joins the two sections of protected roadway jutting out from the mainland and island shores of the bay, is 2,472 feet long. Of this portion, one hundred feet is taken up by the roller lift bridge.

The protected roadway is 110 feet wide at the top and 154 feet in width at the water-line. The arch-bridge portion narrows to a width of 66 feet, and the roller lift bridge is 44 feet wide. In addition to the Galveston County highway, paved with vitrified brick and used by vehicles and pedestrians, the causeway contains trackage for the Gulf, Colorado & Santa Fé, the Trinity & Brazos Valley, the Southern Pacific, the Galveston, Houston & Henderson, the Missouri, Kansas & Texas of Texas, the International & Great Northern and the Galveston-Houston Interurban. All rail on the causeway is of 90-pound steel.

The great roller lift bridge supported upon its gigantic pivot pier is easily the distinctive feature of the causeway. Bridge, pivot pier and equipment bring the total weight of this portion of the structure to 10,886,200 pounds. When raised, the topmost portion of the bridge is 165 feet above the surface of the roadway. Seventy-eight by 553 feet in size, the concrete pier is among the largest single pieces of concrete construction in the Southwest. It rests upon 532 creosoted pine piles 30 feet in length, and driven into the clay subsoil found in the bed of Galveston Bay after excavating to a depth varying from 11 to 18 feet. The pier proper is formed of 3,800 cubic yards of concrete weighing 7,600,000 pounds, reinforced with 3,200 pounds of steel bars imbedded in the concrete. The bridge alone weighs 3,283,000 pounds, of which 700 tons consist of steel and the remainder of the 300 cubic yards of concrete used as a counterbalance.

So accurately is the huge structure balanced, that it is raised with small effort by a 50 horse-power electric motor. There are two of these motors, installed in the concrete house on the west side of the causeway. Should both fail through any reason, there is a 50 horse-power gasoline engine with storage batteries capable of storing electricity sufficient to operate the bridge for several days. As a last resort the bridge is equipped with a transmission gear, making it possible to raise and lower the great weight by hand.

The arch bridge portion of the causeway, which forms the center of the structure, is composed of twenty-eight concrete arches, each sweeping across a 70-foot span and built with a 9-foot elevation. The arches were constructed in four units of seven arches each. Firmly founded in the clay bed of the bay, each is supported by a pier containing 1,300 cubic yards of steel-reinforced concrete, which caps a group of 30-foot piling of barked yellow pine.

Sheet steel coffer-dams were used in excavating the bay bed to a depth of 18 feet. The dams were composed of steel piling 3 feet in width, each with an interlocking device that made the structure water-tight. The concrete mixture was poured from the mixing apparatus on barges moored alongside the coffer-dams, and the piers were built up until the top of the pier-head is two feet above the water-line. Twenty-eight days were allowed to elapse after pouring, before the concrete was touched, in order that the maximum of hardness might be obtained. Each pier is 27 feet through the base. The protected roadway portion of the causeway, which takes up 10,170 feet of the entire length of the structure, juts into Galveston Bay 4,640 feet from the mainland shore, and 5,530 feet from the shore of Galveston Island. The outer edges are defined by two parallel lines of concrete piling 154 feet apart, between which is placed thousands of yards of filling. These lines of piling are joined and insured against buckling by open-hearth steel anchor-rods, placed at intervals of four and one half feet and connected by turnbuckles.

From the concrete cap that tops the lines of piling the protective concrete slab-work slants upward to the outer edges of the roadway 110 feet wide. The construction of this concrete piling makes the long wall, washed by the waves of the bay, absolutely water-proof. The lower end of each pile is shaped with a tongue and groove five feet long, and the remainder of the pile is edged with two grooves, each thirteen feet in length. When the piling was driven five feet into the clay, leaving the tops about three feet above mean low tide, the two grooves on adjoining piling left a thirteen-foot cylindrical opening which was filled with mortar. This formed a dowel which caked the joints between piling and made the long line water-tight. Driven into the heavy clay without the aid of water-jets, it was necessary to cap the head of each concrete pile with a cushion of sand and sawdust to prevent the concrete crumbling under the blows of the pile-driver. Each pile was kept under water ten days, and then stored for two months before being placed in the structure. Placed end on end, the piling used in this portion of the causeway would reach forty miles.

In a semi-tropical country of torrential rains, the drainage of the roadway was no small problem. The system installed is a twelve-inch bell and spigot tile drain laid in a trench through the filling. This drain empties into a combination silt-basin and man-hole placed every 600 feet on the island end and every 650 feet on the mainland end of the causeway. The water is carried through the filling and out through the concrete slab slope-protection in an eighteen-inch vitrified salt-glazed hub and spigot stone-

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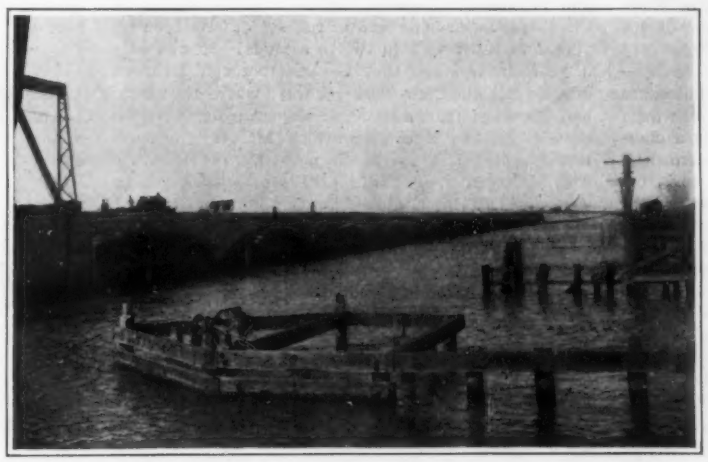
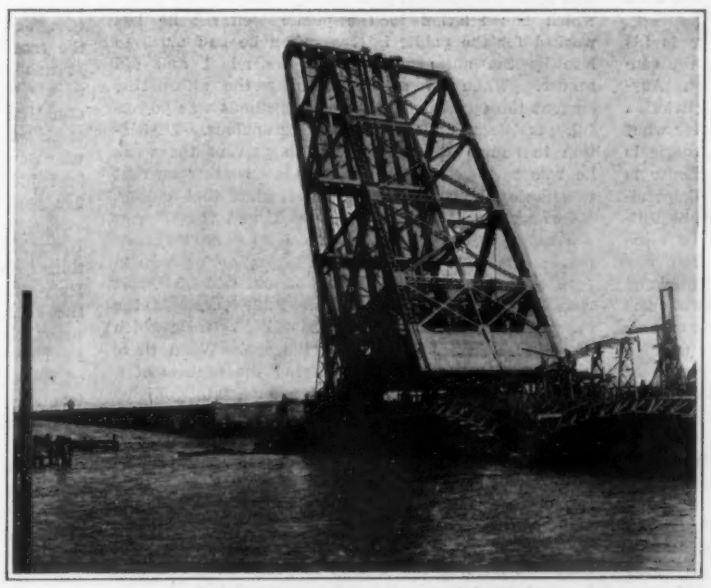


Last unit of seven arches to be completed. The wooden forms are being removed.

The last day's work. Paving with vitrified brick the last stretch of the Galveston County highway on the island end of the causeway.



The bascule bridge which is one of the distinguishing features of the Galveston causeway.

George Westinghouse—Engineer and Inventor

An Inventor Who Has Worked For the Public Interest

By Arthur Warren

AN editorial request for an article on George Westinghouse that shall deal with the phase of his character which may be regarded as most helpful to the general reader meets with this difficulty—there are so many phases of his character which are inspiring, helpful, it is difficult to choose between them for the indicated purpose. But there is a characteristic of the man that is commonly disregarded by the many chroniclers of his genius and his work, for the reason, perhaps, that the chroniclers have been less fortunate than the present writer, who for many years has been able closely to observe the great engineer in practically all the branches of his activity.

The characteristic alluded to is George Westinghouse's capacity for working with his hands, as well as with his head. He is a skilled workman. In boyhood he learned the uses of tools; in youth he practised every resource of the machine-shop; during the years of manhood he has worked in the same way as competently as if his livelihood depended on the manual exercise of his mechanical skill. He knows the draughting-board as well as the turret-lathe or the milling machine. No one has to tell him whether a thing is planned right or wrong, or made right or wrong; his own inspection is a severe test. He will talk with you about a new idea, or a new way of doing things, and illustrate his meaning with a pencil sketch drawn on the spot. In this way he has often convinced the skeptical. And the skeptical of this world are as numerous as the sands. They are forever crying "impossible."

The latest "impossibility" which he has made a success is the air-spring for automobiles. One day some men from up-state New York brought him a contrivance which they had designed and tried. They frankly said it was imperfect, and asked him for advice. The man who had done so much with compressed air for train-brakes would surely know, if any one could know, how to seal the air in cylinders which might be substituted for motor-car springs. Many people had tried to do this, but none had succeeded. Mr. Westinghouse said it could be done, but that other things needed doing, too, in order to obtain practical results. He bought the control of the invention and then set about perfecting it. He sealed the air with oil, and invented and inserted a little automatic pump to keep the oil in the proper places. For three years he experimented with the spring; redesigned the whole affair, and not many months since placed it on the market in readiness for the season of 1912. In this device Mr. Westinghouse believes that he has produced an invention not less important than the air-brake itself. It can be applied to any power-driven vehicle, and even to railroad cars.

Another characteristic of Mr. Westinghouse is his unbeatable hopefulness. Call it, if you like, the constant manifestation of a sanguine temperament. Anyhow, there it is, the ever-cheery mind, that conviction that whatever he undertakes must win, no matter what the forces of opposition may be. Andrew Carnegie is credited with the remark: "George Westinghouse is a genius who can't be downed." Back of the hopefulness which always looks on the bright side while estimating clearly the obstacles which have to be overcome, there is a superb, astonishing vitality. Not only is Westinghouse big mentally, he is big physically and filled with power. Illness he has never known. His vitality, his temperament, his training and his outlook on life have more than once carried him safely through dark and treacherous places. Through the panic of 1907 and the long consequent fight which has become historic, he preserved his ardor with a strength, cheerfulness and unbroken capacity for work which amazed even those friends who had long known his possession of these qualities. The past four or five years have, indeed, been among the richest in his inventive genius. Not only has the air-spring been brought forth and perfected within this time, but the geared turbine drive for ship propulsion, as well. The late Rear-Admiral Melville, an old and very dear friend of his, was associated with Mr. Westinghouse in the early stages of the latter invention. The perfected devices by which the success of the geared drive has been demonstrated in actual service on the United States steam collier "Neptune," and elsewhere, are regarded by engineers as among the most remarkable products of Westinghouse's genius. And there is also the ingenious invention for controlling the operations of a ship's engines by a device placed on the navigating bridge of the vessel. The movement of a lever on the bridge starts or stops the engines, reverses them, and regulates the speed. By its use the engines of the "Neptune," going ahead at full speed, have been reversed to full astern in twelve seconds! It was only a year or two ago that the Interborough Railroad adopted for the New York Subway, where the traffic had increased from 400,000 passengers a day to more than a million, a coupler which Mr. Westinghouse had invented and by which not only the cars are coupled together, but the air-brake connections as well, and all by a single automatic operation. At the same time the subway trains were equipped with the new electro-pneumatic brake produced by the Westinghouse Air Brake Co., of which Mr. Westinghouse is still the president, after serving more than forty years in the same capacity. The new brake enables the trains to approach nearer to the stations before reducing speed, thereby greatly reducing the running time from end to end of the line, and enabling more trains to be run in a given time. And by the absolute control afforded, a given train increases its day's mileage and, consequently, carries more passengers in the day than could otherwise be the case.

From the beginning of Peter Cooper Hewitt's work on the now famous mercury vapor lamp, and the "rectifier" which is destined to become even more famous and important, Mr. Westinghouse extended to the inventor his persistent encouragement and material support. Two years ago, at the conclusion of a patent fight which has had but few equals in this or any other country, after all the tribunals of the Patent Office and the courts had decided in the inventor's favor, declaring him to be the discoverer of a fundamental principle in electric science, the original inventor of a remarkable static device for transforming alternating currents into direct currents, Peter Cooper Hewitt said to the writer: "The interest which George Westinghouse has taken in my work, and the benefit of his vast experience, have been to me a help of inestimable value. He knew I was right and he never weakened. To me he has been a mighty fortress."

But while an enumeration of the inventions of Mr. Westinghouse, and those in whose development he has participated, and those which he has otherwise fostered and encouraged, might be interesting to the curious in these matters, there is no space available here to print even the names of the patents which stand to his personal credit. What is of more interest and importance is the spirit which has brought forth these inventions and which has contributed so greatly to the progress of our times. This is a far-sighted and liberal spirit in which integrity and courage are strong and conspicuous powers. George Westinghouse is not one who seeks his personal gain when he advocates a policy which has relation to the public welfare; he has worked for the public interest when he had much to lose by the antagonisms which he might and did arouse. When he was introducing the alternating current the opposition to the new methods was powerful, persistent, and not always scrupulous. Legislation in many States attempted to prevent the work he was seeking to achieve. The alternating current was declared "impracticable," and when that epithet did not suffice, "deadly" was added, and the country was assured that in any city or district where an alternating system might be employed, people would go in peril of their lives, and property would be in constant risk. Westinghouse persisted, and the result is the existence of great electrical distributing systems which have become commonplaces of the age. When there was a great outcry for electrifying the tunnels of a main-line railroad into New York after a fatal collision and fire, he warned the public, through the press, that they were in danger of plunging from one disaster to another, and that the wisest course would be to wait until some important problems were worked out and the best safe-guards ascertained. There were few who could understand why a man whose business it was to "push" the electrical industry and to secure great contracts should "call a halt to progress." For that is what most people thought he was doing. But he was actually warning them that electrical and other invention had yet to catch up with the public's panicky zeal.

George Westinghouse was born at Central Bridge, Schoharie County, New York, October 6th, 1846. His father was a manufacturer of agricultural machinery, and in his workshop, which is still in operation in Schenectady under the name of "The Westinghouse Company," the boy got his first experiences with mechanical matters. He used to work there out of school and college hours, because it was his greatest pleasure to do so. He did not neglect his studies, but his teachers encouraged him to develop his inclination for mechanics. This was especially the case with the president of Union College, who had a very strong appreciation of the mechanical genius of the youth who, at the age of 15, had built a rotary engine. Before he was 17, young Westinghouse enlisted for the civil war. He served in the infantry, cavalry, and navy, in the latter joining the engineer corps. In August, 1865, obtaining his discharge, he returned to Union College, passing his examinations so creditably that he entered the sophomore, not the freshman, class. In the same year, 1865, he invented a device for replacing derailed cars on the tracks. Soon after that he invented another device for railroad work, and while introducing this to railroad officials the idea of a power brake occurred to him. That was in 1866. In 1867 he had worked out his plans for the air-brake and had protected it with patents. By this time he had removed from Schenectady to Pittsburgh. In 1868 the air brake was first tried on a train. It was an immediate success. The inventor was at this time only 22 years of age.

Although fame and fortune came to him very early in life, they came as the results of hard work and persistence. There was no luck in the matter. The enormous growth of railway mileage and operation in the past forty-two years would have been impossible without the control of train movements which Mr. Westinghouse's invention gives, an invention which still advances in efficiency from year to year.

After the air brake came the introduction of switch and signal systems. From these to the study of electricity was a natural step. It was in 1885 that he began to develop the alternating current system. The result is part of the history of our time. He also invented a system for facilitating and controlling the flow of natural gas over long distances, both for domestic and commercial fuel. He was early in the field of gas-engine development; he brought the Parsons steam turbine to America and incorporated improvements of his own; he built the first huge electric generators for Niagara, and for the electric railways of New York; he created, organized, and directed in this and other countries great manufacturing and engineering companies employing many thousands of men, and a hundred and fifty millions of capital. In Pittsburgh and vicinity a hundred and fifty thousand persons draw their livelihood through the immense industries which he built up. To-day, at 65, he is as active as ever, as sanguine, as inventive.

A conspicuous tribute to his integrity was his selection, in June, 1905, along with ex-President Grover Cleveland and Justice Morgan J. O'Brien, as one of the trustees of the Equitable Life Assurance Society. It was in a time of general unrest following disclosures concerning insurance affairs and the financial situation. The controlling interest of the Equitable stock was placed in the hands of these three trustees, who were given full power to vote it according to their best judgment. The trusteeship was for a term of five years. The selection of Cleveland, Westinghouse and O'Brien met with universal public satisfaction. Upon Mr. Westinghouse have been conferred decorations from the French Republic, and from the Kings of Italy and Belgium. He was the second recipient of the John Fritz Medal, the first being his friend of many years, Lord Kelvin. The Königliche Technische Hochschule of Berlin gave him the degree of Doctor of Engineering; Union College gave him the Ph.D. He is an honorary member of the American Society of Mechanical Engineers, and was its president in 1910; he is one of the two or three honorary members of the American Association for the Advancement of Science; and an honorary member of the National Electric Light Association; and only the other day the Edison Medal was awarded to him by the American Institute of Electrical Engineers; it was conferred upon him at the meeting in May last.

Solubility of Amber.—Coffignier, in experimenting with various solvents for amber, furnishes the following figures, the percentages indicating the quantity of amber remaining undissolved in the liquids after boiling for two hours: alcohol 85.7 per cent, wood alcohol 88.7 per cent, amyl alcohol 75.8 per cent, ether 81.2 per cent, chloroform 22.7 per cent, benzol 78.8 per cent, acetin 76.7 per cent, oil of turpentine 83.1 per cent, benzaldehyde 67.9 per cent, aniline 69.3 per cent, amyl acetate 70.0 per cent, carbon tetrachloride 88.5 per cent.

The Winnipeg Motor Contest

A Motor Show for Farmers

THE annual motor competition is to be held at Winnipeg, Manitoba, from July 3rd to July 20th, under the auspices of the Canadian Industrial Exhibition. This is only the fifth year of the competition, but the event has already become a classic in a great and rapidly growing field of human endeavor. The world is on the threshold of a change to mechanical power in agriculture. The plow has developed successively from the crude stick to the wooden plow, the iron plow and finally to steel—from the single tool handled by the power of one man's muscle, to the crude ox plow, the walking plow, the sulky, the gang plow and finally to a combination of iron and steel that cuts a dozen furrows at once. The power that tills the soil has been shifted from man to brute, and now for the first time, the farmers everywhere are learning to use the engine.

The railways and steamships sprang into being, through the steam engine, and manufacturing has been concentrated into one factory where one hundred grew before, thanks to the removal of power limitations. And now agriculture, the fundamental occupation of mankind, is being awakened as no other one factor has ever awakened it, due to the coming of the self-propelling engine to do the farmer's plowing, his sowing, and harvesting, his threshing, hauling and grinding. The Winnipeg Motor Contest is to the manufacturers who are supplying this new power for the farmer, what the five-hundred-mile Speedway race is to the automobile world—a contest in which engineering skill, the tractioneer's art, and the craft of the lesser captains of industry are brought into play in a great sporting event, behind which lies a desperate struggle for popular favor and popular dollars.

Other cities have held motor contests. Brandon, Manitoba, had one in 1909; they have been held in England and France, in Belgium, in Italy and the Argentine, but nowhere on the face of the earth have the greatest men in a great and growing industry been drawn together year after year as eye witnesses to such a struggle. From no other spot has emanated so much that is vitally interesting, so much that has been widely accepted, as from the smooth prairies to the north and the west of Canada's Chicago —the young giant, Winnipeg. Every year for two weeks the desks and offices are empty, which for the other fifty are filled by keen, aggressive manufacturers, striving to solve the problem of making the farm a factory, through the introduction of mechanical power. For two weeks the mechanicians gather from the factories and the colleges of Agricultural and Mechanical Engineering send forth the men who must teach the youth of the land what this new factor in industrial history means. Farmers and business men follow the contest, energetic journalists report the event for hundreds of publications, and Winnipeg becomes the Mecca for men of every station that will be affected by this great development.

And what is the tractor? The term "tractor" is merely a newer and more convenient term to designate the traction engine, and the traction engine is a power plant on wheels, propelling itself from one point to another when necessary, by the power of a steam or internal-combustion motor, or standing still and drive stationary machinery with a belt when occasion requires. Traction engines were first made for threshing, after the demand for faster operation had caused the general substitution of a portable steam engine for the ancient sweep or tread mill run by animals. It was not at first designed for heavy loads, its wheels were light, and its gears were thin and brittle. When great bonanza farms appeared on the Dakota prairies, even faster threshing became necessary, and bigger engines followed. Then the more ambitious farmers, spurred on by the thought of hidden wealth underneath the soil and indifferent to the cost, so long as they produced results, lifted the threshing engine from its position and forced it to pull their common plows. They tore to pieces both motor and plows, but continued undismayed. By sheer persistence in what men called their folly, they forced manufacturers to begin their work anew and build engines rugged enough to stand the heavy tug of the plows behind. The plow manufacturer, too, was forced to make the plow an engine gang of sterner stuff, or else see his product scattered piecemeal over the prairie, by men who were merely foreshadowing a far reaching economic change in their stubborn efforts to solve their individual problems.

Thus the traction engine came into its own as a field locomotive, and instead of being merely a self-moving stationary power, it is now an aggressive rival of the twenty-five million horses found on the farms of the United States. Every operation in the handling of the wheat crop, oats and flax can be done with the tractor. Everything in connection with the corn crop up to the moment of planting can now successfully and economically be done by this revolutionary engine, and its work begins again with the harvest of the crop, the filling of the silo, the shelling of the corn, and the shredding and baling of the fodder. Its use in the hay field is as yet confined almost entirely to the rapidly growing practice of baling the bulky crop for more convenient storage and shipment. The tractor is building the roads and hauling material over them. It is helping to build the railways which carry long train loads of power-farming machinery into the great Northwest, and bring back other long train loads of grain for the mills and the seaboard. It is hauling logs and sawing them into lumber to make the farm buildings. It is performing a variety of tasks almost miraculous to those who think back a decade to a time when power on the farm meant only the annual visits of the threshing rig.

Now the tractor has been diversified into a hundred different forms and sizes. It follows the principle of the steam engine on the railroads, the automobile on the highway and the stationary gas engine of the central power plant. Its possibilities are so vast and so incomprehensible that inventors see only one of a dozen of the scores of big problems involved, and are consequently producing infinite varieties of tractors differing to the minutest detail. Promoters are selling stock, salesmen are busy demonstrating the qualities of their respective machines, advertising writers are pouring out volumes of information of more or less reliability, and in the midst of this amazing progress the individual farmer stands, sounding the eternal question of the type best adapted for his conditions. Here is where the motor contest comes to his aid.

The two most important tasks of the year on the average farm are plowing and threshing, which also represent respectively the pulling and the belt-driving involved in all other operations. In the motor contest the tractors are first tested on a friction brake which represents the separator or other stationary machine. For two hours a steady load is maintained and every favorable condition given which will enable the competitors to demonstrate economy in fuel and water consumption, steadiness of running, absence of distress requiring unusual attention, and all the qualities which go to make up a practicable stationary power plant. Then for a half hour, the conditions change, and every effort is made by the competitor to carry as high a sustained load as can be carried without squandering fuel or damaging the engine. At the conclusion of each test, the crowd flocks around the official observers to note the consumption of fuel and computing of horse-power hours developed from the observations made during the run. With each announcement of results as the days of the contest go by, interest and speculation increase. The successful competitors enjoy their honors, and the defeated ones buckle on their armor for the completion of the test on the plowing field. For ten days interest centers around the two brakes in a corner of the exhibition grounds. Horse races, side shows, aeroplanes, the great exhibits of live stock, and the fat of the land from the "Bread Basket of the World" call but faintly so long as there are engines puffing and chugging away on their monotonous brake tests.

For ten days this continues; then the roads to the north and west are filled with a strange procession of huge steam monsters filling the high-crowned road from side to side, gasoline and oil tractors taking short cuts across the prairie, and scurrying automobiles passing back and forth as tenders to the slow moving participants in the race. The engines are filled, keenly sharpened plows are attached, and from three to five hours of work ripping up the virgin sod begins for each tractor. Careful observers watch the fuel consumption, the condition in which the engine is found at all times, the distance traveled between times of taking fuel and water, the capacity in acres per hour, the actual draft of the plows, and the horse-power developed. Everyone is too busy to note what the other fellow has done.

In contrast to the definite knowledge possessed by everyone at the conclusion of the brake test, only the meager details unofficially reported by the competitors themselves are known. The judges have been working over an area a mile long and a half-mile wide, and meet only occasionally at the tent. At the close of the test they repair immediately into closed session at one of the hotels. They emerge only long enough to score the engines with a critical eye—a day's job, for there are usually twenty-five to thirty in the test. They consider the materials and construction, the ease of manipulating, steering, lubrication, etc., the accessibility of parts for repair or adjustment and the protection of all parts from dust and wear.

For two to three days the deliberations continue. The majority of competitors leave town in the interval, but the faithful—those whose hearts have been in the thick of the fight throughout the contest and the weeks of preparation beforehand—await with anxious hearts to hear of the results and wire them to the respective factories. When the results are known, waiting presses groan with the rush of editorials and advertising which had been all but prepared, lacking only the final lines announcing the positions of the winners. Then begins far and wide over this country and over the world at large, a period of argument and criticism—of celebration and disappointment—as the results are studied, debated, picked to pieces and put together again in a thousand ways to bring out the good, the bad and the indifferent in all the machines. The victors gloat over their less fortunate rivals and the losers point with pride to the many points in which they scored over the medal winners, for, after all, the results are close, the victory is seldom decisive, and the possibility of error so great that in every class diplomas might well be awarded to all who finish the tests.

The motor contest has given Winnipeg a distinction which has linked its name forever with those others which mean much in farm machinery history. It has focused the eyes of the world upon Northwest Canada as the home of brilliant opportunities for large-scale farming. It has taught manufacturers how to test their product at the factory, and, by testing, greatly to improve what is being offered to the farmers. It has given the public reliable information as to the performance of tractors and, originating as it did at a time when the gas tractor was practically an unknown thing, it, probably more than anything else, has given manufacturers and the public at large the sustained confidence in the gas engine which has made possible the enormous growth of the last five years.

The findings of the motor contest are seldom conclusive. The apparatus has been such as to give comparisons rather than absolutely scientific results. But, planned first merely as an attraction for a provincial fair, it has grown into a world-famous event, and only now has the city of Winnipeg begun to recognize its significance and to provide the funds and facilities necessary for carrying it on with proper regard for its importance. This year, for the first time, the contest promises to be staged adequately, and the results which will be available the last week in July, are being awaited with the liveliest interest.

The Cause of Welsh's Death

THE special board of officers designated by the Secretary of War to inquire into the cause of the aeroplane accident in which Lieutenant Hazelhurst and Mr. Welsh, demonstrator for the Wright brothers, lost their lives, have submitted a preliminary report. In order to make the test, to ascend to the height of 2,000 feet in ten minutes, Welsh, who was in charge of the machine with Lieutenant Hazelhurst as passenger, after rising to about 150 feet, had dived at an angle of about 45 degrees, to gain momentum for a sharp rise. The reversal occurred probably too suddenly. The combined weight of the two men was 255 pounds, and five bags of lead were carried to bring the load up to 450 pounds, as required by the terms of the contract. The quick reversing of the direction of the plane's flight and the high speed of the motor, and the strain of the load, probably broke every brace and stay in the machine. Welsh was found under the wreck. The board placed the blame on Welsh and found that the accident occurred from no fault of the aviation detail. In order to make a thorough inquiry into the matter, and to avoid criticism, a special board to investigate the accident was appointed wholly from the Signal Corps, Secretary Stimson, designating Major Walton H. Gordon of the Inspector General's department, to make a separate investigation.

A Collision in Mid-air

ON JUNE 19th, Capt. Dubois and Lieut. Albert Peignan, aviator officers of the French army, collided in the air while circling around the military aviation field of Douai, and came to a violent end. This is the second collision of flying machines on record. The first accident occurred at the Johannisthal Aviation Grounds, outside of Berlin, on March 13th last. The machines in that instance were flying around the pylons and dealt each other a glancing blow. Both fell, the pilots, however, escaping unhurt. In the terrible Douai accident, the machines crashed together head-on, interlocked, and fell to the ground one tangled mass of wreckage. The accident seems to have been caused by a heavy fog which prevented the aviators from seeing their way.

The "Electric Niagara" Delusion in France

A New Supposed Method of Preventing Hail

THE annual damage wrought by hailstorms throughout the world may be very roughly estimated at two hundred million dollars. This estimate is based upon the exact statistics that exist for a few countries in Europe. The magnitude of these figures explains the eagerness with which every proposed means of averting the terrible scourge is given a trial, however irrational the expedient and however costly the experiment.

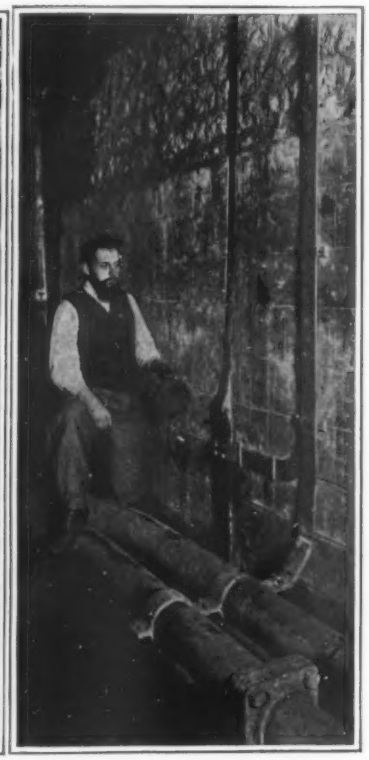
Bombarding the clouds with cannons, rockets and bombs has cost the agriculturists of Europe millions of dollars, and will probably cost millions more before the absolute inutility of this method of fighting the hailstorm is universally admitted. In a relative sense only, the "paragrêle" delusion of the early decades of the nineteenth century was inexpensive; but the metal-tipped wooden poles, upward of a million of which were set up in European fields and vineyards in the hope of "drawing the electricity from the clouds," must, in the aggregate, have cost a sum that would have gone a long way toward maintaining a rational system of hail insurance.

The latest of these ill-fated experiments is now in full activity in France. The "electric Niagara" is so called because, if we may believe its inventor, it draws down veritable "torrents" of electricity from the clouds. It is, in fact, a gigantic lightning-rod of pure copper, terminating in a cluster of gilded copper points. Under the auspices of a government commission these rods are now being installed in many parts of France, and one has been erected on the Eiffel tower by the municipality of Paris. It is proposed to set up lines of "Niagaras" at intervals of a few miles across the most frequent paths of hailstorms, constituting what is called, in equally picturesque terminology, "electric dams." The whole scheme has been described in several recent magazine articles (*La Nature*, Paris, 6 janvier, 1912; *Cosmos*, Paris, 23 dec., 1911; *Country Gentleman*, Philadelphia, March 2nd, 1912; *American Review of Reviews*, New York, April, 1912; etc.).

No one has even attempted to explain why, assuming that these overgrown lightning-rods will locally neutralize, to a large extent, the electric potential between the clouds and the earth, the formation or the fall of hail storms should thereby be averted. This very improbable assumption seems to be taken for granted by the promoters of the scheme. An alternative line of argument would, of course, be to regard the process as purely empirical and to rely upon the fact that, the mechanism of the hailstorm being but imperfectly understood, one is justified in applying a method that has no *à priori* basis. This sort of experimenting is, in fact, quite justifiable, but it must be judged by its fruits; and already, in the early stages of the French undertaking, the fantastic "Niagaras" have been found wanting, if we may judge from the article in *Cosmos* referred to above. It is said that the vogue of the "paragrêle" declined very suddenly about the year 1827, after a large number of these contrivances had been knocked over by hailstorms! If the "Niagaras" are spared, it will probably be because they are more firmly fixed to their moorings.

The final argument, however, against all the devices for hail protection heretofore in vogue—from the time when our ancestors hurled darts and javelins at the clouds down to the present day—is the fact that the natural forces at work in the hailstorm are so tremendous as to make the protective measures of mankind comparatively insignificant and negligible.

View showing the copper bands or strips extending down the tower pillars.



Connection of the lighting conductors with the pipes of the hydraulic elevators.

Rods on the Eiffel tower tipped with a cluster of gilded copper points.

Cottonseed and Its Uses.

THERE was a time in the history of American industry when cottonseed was a mere garbage. To be sure, small quantities of it were used as fertilizer and as feed, but most of it was dumped into remote places or thrown into running streams. Indeed, the proper method of disposing of what was regarded as a troublesome waste material at one time called for legislative action, for the cottonseed rotted when dumped on dry land, and polluted water when cast into streams. What was once a garbage is now converted into a wholesome food product, a valuable feed stuff, and other useful products. The annual crush of cottonseed in this country is now nearly four million tons. The number of mills carrying on this work increased from 7 in 1860 to 26 in 1870 and 810 in 1910.

The number of persons engaged in the industry is now about 21,273. The total primary horse-power employed in the industry is 185,683, nearly all of it being steam. The capital invested is $91,086,000. The total cost of seed delivered at the mill was $78,111,857 in 1909. The total value of the crude products manufactured from this seed amounted to $107,528,204 in 1909, an increase of more than 150 per cent in ten years. In 1909 crude oil represented 51 per cent of the value of all products; cake and meal, 38 per cent; hulls, 7 per cent; and linters, 4 per cent.

Cotton growers and farmers throughout the cotton belt are beginning to realize more and more the value of fertilizers in increasing the yield of their crops, and especially the cotton crop. Among the most important ingredients of fertilizers are ammoniates, of which cottonseed meal is one of the best, and it is largely on this account that the oil mills have taken up the manufacture of fertilizers. The output of fertilizers of this character is now 214,000,000 tons, valued at $4,275,000.

Formerly there was much prejudice against the use of cottonseed oil for edible purposes. The public, however, is gradually realizing that when cottonseed oil is carefully manufactured from seed in the proper condition, it is equal to any other vegetable oil and preferable to many of the animal fats now consumed.

The many uses to which cottonseed is put is astonishing. The cottonseed itself consists of linters, hulls and meats.

From the linters are manufactured padding, wadding, stuffing materials for pads, cushions, comforts, horse collars and upholstery; absorbent cotton, mixing with shoddy, mixing with wool in hat making, mixing with lamb's wool for fleece-lined underwear; felt; low-grade yarns, which in turn are employed for the manufacture of lamp and candle wicks, twine, rope, carpets; cellulose, which finds a use for artificial silk, writing paper, and a basis for explosives.

The hulls are worked up into feed, fertilizer, paper stock, household utensils and fiber for stuffing horse collars and for serving as a basis for explosives.

From the meats the primary derivatives are cake and meal and oil. The cake and meal are utilized as fertilizer, dye stuffs, feed for cattle, poultry, horses and swine; as an ingredient of confectionery and bakers' flour. The oil obtained from the meats consists of summer yellow oil and soap stock. From the summer yellow oil there is made winter yellow oil; summer white oil, from which lard compound and white cottolene are obtained; stearin, which enters into the manufacture of butter oil, cooking oil, salad oil, imitation olive oil and oleomargarine; and miscellaneous substances employed for setting olives, packing sardines, emulsions for medicinal purposes, cosmetics, illuminating oil for miners' lamps, lubricating oil, tempering edged tools, mixing with putty, paints, automobile tires.

Another derivative of the oil is soap stock which is used in making soap, washing powder, glycerine, candles, olein, and roofing tar.

Formerly hulls were used as fuel in generating power for oil mills, and the ashes thus obtained were found to have a commercial value as a fertilizer. The importance of hulls as a product, however, resulted from the discovery that a mixture of hulls with cottonseed meal makes an excellent feed. The demand for them in the stock-raising and dairying industries is now so great that they are no longer used for fuel.

The chief demand for cottonseed in cake and meal is for stock feeding purposes, and as an ingredient in the manufacture of fertilizers. For both these purposes this product has been used so extensively that now its value is almost equal to that of oil. The flour made from the meal is used in the manufacture of bread, cakes and crackers. Although the methods of extracting the oil from the seed are practically the same as they were thirty years ago, despite many changes and improvements in machinery, the methods of refining have improved greatly. With each improvement new uses for cottonseed oil have developed, among the most important of which is the manufacture of lard compounds.

A Woman Killed in an Aeroplane

A FEW weeks ago we recorded in these columns the fact that Miss Julia Clarke had received her aviator's license. She met her death on June 17th at Springfield, Ill., by falling into a tree, Just as she was the third woman who received a pilot's license, so she is the third woman to lose her life in an aeroplane accident.

The Heavens in July

A Radioactive Nova; the Rotation of Uranus; the Planets and Stars

By Henry Norris Russell, Ph.D.

TWO announcements of interest to astronomers have been made during the past month. The first in a cable message from Kiel—that is, from the office of the *Astronomische Nachrichten*, which is the distributing and collecting center for astronomical news in Europe—declares that Prof. Küstner of Bonn has found "dark lines of uranium and radium emanation" in the spectrum of Enebo's Nova in Gemini.

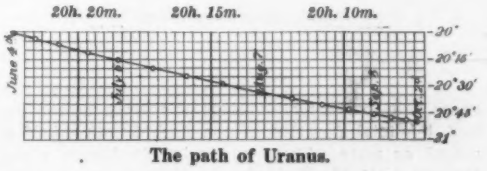
No further details have reached the writer; but the high ability and extensive experience of Prof. Küstner make it certain that he must possess ample and convincing reasons for this remarkable statement. It is too soon for any attempt to interpret this discovery; but the suggestion that the tremendous outburst of light and heat which accompanies the appearance of a "new star" is in some way of radio-active origin, is too plain to be passed over. What the details of the process are, we may find out, or we may not. It may be just as well that such violent outbursts of the tremendous energy stored in the heavier atoms, as may in this case be assumed, cannot be evoked in our laboratories. The results might be disastrous to many more than the experimenter.

The second announcement, made by Dr. Percival Lowell, is that his assistant, Dr. Slipher, has for the first time obtained evidence concerning the rotation period of the planet Uranus. Spectroscopic observations show this to be a little over fifteen hours, the direction of motion being retrograde.

We may pause before discussing this more fully, to consider how we may find the planet in question, which is now very favorably placed for observation.

The smaller diagram on this page enables one to read off the Right Ascension and Declination of the planet for any day in the month. Plotting these on the larger star-map, which is more extensive, but on a smaller scale, we find that on July 1st the planet is about 2 degrees south and west of a little triangle of fifth-magnitude stars, which themselves are easily found by a line drawn from Alpha Capricorni through its neighbor Beta and carried rather more than as far again. During the month he moves about 1½ degrees in a direction a little south of west. His motion is too small to be easily detected between one night and the next, but is easily discernible in a week or two.

This is an excellent opportunity to identify the planet, as there are no fixed stars of comparable brightness near enough to be confusing, with the possible exception of Sigma Capricorni, a star a little above the sixth magnitude, which lies about 2½ degrees west of the small triangle already mentioned, and 1 degree north of the planet's track.



The path of Uranus.

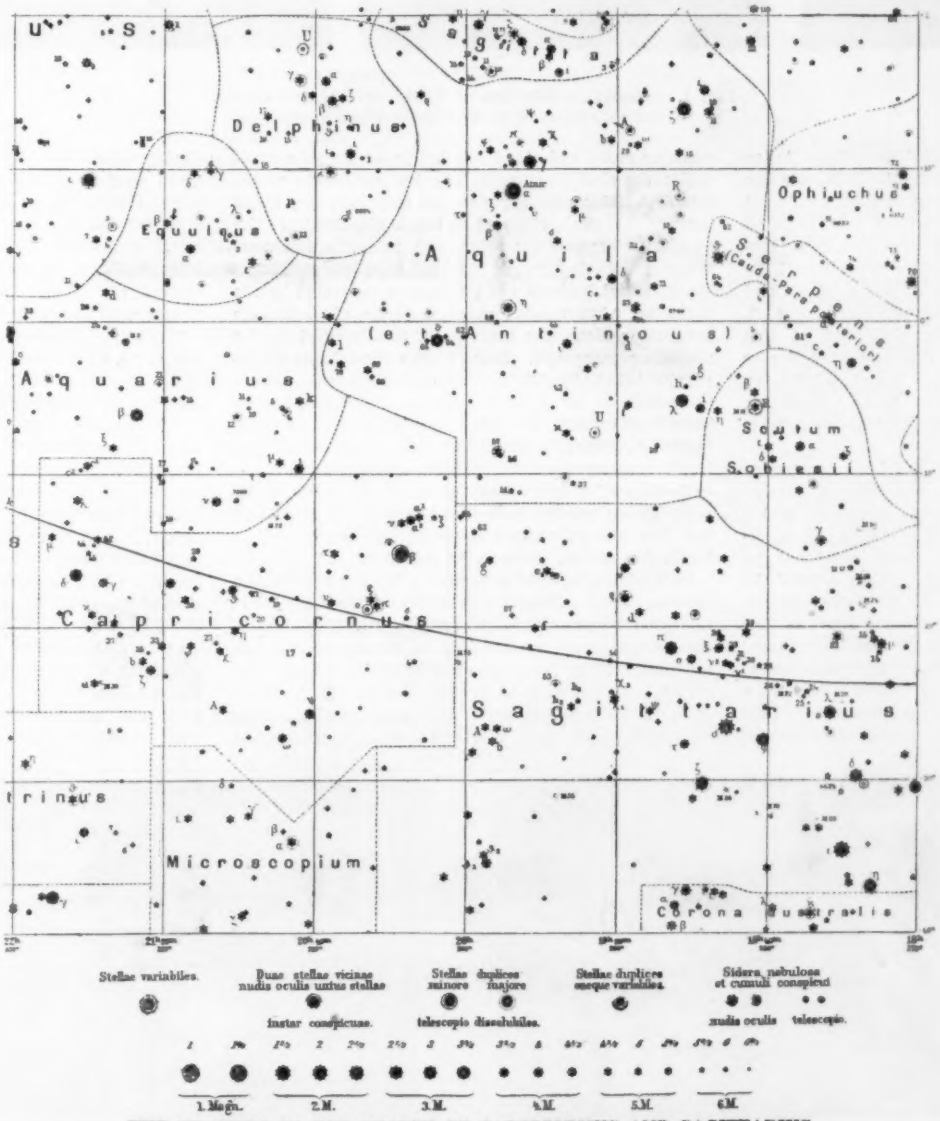
To the naked eye Uranus is a mere speck, of the sixth magnitude, just visible on a dark sky. In a field glass it is fairly conspicuous, but can be distinguished from the stars only by its motion (unless one knows its position in advance). A small telescope brings out the decided greenish color of the planet, but a power of at least 100 diameters is necessary to show its disk to the novice, for it appears only 3.6 seconds in diameter—apparently but one-eleventh the size of Jupiter.

Even the most powerful instruments fail to show any markings on the planet's disk sufficiently well defined to make it possible to find its rotation period. We may guess that the inclination of its axis to the orbit plane is very high, for in all other cases, the orbits of the closer satellites of the planets lie nearly in the equatorial plane of their primary; and the satellites of Uranus move in orbits whose plane is almost at right angles to that in which the planet moves about the sun, but is actually tipped a little more than 90 degrees, so that the motion of the satellites, if viewed from a great height above the plane of the planet's orbit, would seem to be in the reverse direction from that of the planet. At certain times we (looking from our position close to the center of the planet's great orbit) see the satellite orbits edgewise; at other times almost squarely in plan. When the orbits are seen edgewise, the planet's disk appears distinctly oval—about as much so as that of Jupiter; but when we are looking squarely down on them, the planet seems circular in outline. This shows that Uranus must be flattened at the poles, and that the equatorial plane must be near that of the satellites' orbits. When we look sidewise at these, we see the planet from the direction of its equator, and the flattening is conspicuous. But when we see the orbits in plan, we are looking almost straight down on the planet's pole, and the apparent boundary of its disk almost coincides with its equator, which of course is circular.

The polar flattening must of course be due to fairly rapid rotation of the planet, and we could safely assume that, since it is much more flattened than the earth, its rotation must be more rapid. But no markings on its surface which would test the question have ever been seen. Under favorable conditions, faint belts have been observed on the disk; but these are continuous (as the belts on Saturn usually are) and one part of them cannot be told from another, so that they leave us no wiser than before.

The only answer of the problem is given by the spectroscope. If the planet is in rotation, one side must be approaching us, and the other receding. If we make a photograph of its spectrum, the lines will be slightly shifted toward the red on one side, and toward the violet on the other, so that they will cross the spectrum at a slant, which will obviously be greater, the more rapid the rotation. In this way Mr. Slipher, with a specially constructed instrument, has found values for the rotation periods of Mars, Jupiter, and Saturn which agree very closely with the known values—thus testing his method—and has shown that the rotation period of Venus must be very long. Uranus is so faint that the obtaining of good photographs must be exceedingly difficult, and the successful issue of Mr. Slipher's work is cause for hearty congratulation to himself and to Dr. Lowell.

Turning to our map, which represents on a large scale the region of the sky which lies near the southern meridian about midnight, we note the bright star Altair at the top, the Milk Dipper in Sagittarius in the lower right-hand corner, and the stars α and β Capricorni in the center. To trace out the rest of this constellation—a curvilinear triangle of rather faint stars—is easy on the map or in the sky.



THE HEAVENS IN THE REGION OF CAPRICORNUS AND SAGITTARIUS

Alpha Capricorni is very well known as a double to the naked eye; and Beta in a field glass. Among interesting pairs for telescopic study may be noted ρ Capricorni (the uppermost star in the small triangle below α and β) which has a companion of magnitude 7.6 at a distance of a little under 3 seconds; π Capricorni (at the southeastern corner of the same triangle) which has a ninth magnitude companion, at a little greater distance; θ Serpentis (shown near the upper right-hand corner of the map) which is a fine wide bright pair, of 22 seconds separation; and ε Equulei (a small star very nearly half way between Altair and α Aquarii) which has a companion at about 10 seconds distance, while the principal star is a close pair, now growing closer on account of orbital motion, and separable only in large telescopes.

At our usual observing hour (10:30 P. M. in the middle of the month) these constellations are all in the southeastern sky. Scorpio is resplendent in the south, and Virgo and Boötes in the west. Hercules and Lyra are nearly overhead. Draco and Ursa Minor are high in the north, Ursa Major well up in the northwest, and Cassiopeia rather lower in the northeast, while Andromeda and Pegasus have risen, and returned to the evening skies.

The Planets.

Mercury is evening star all through July, and is well observable in the latter part of the month, especially about the 25th, when he is apparently farthest from the sun, and sets about 8:30 P. M. He is then in Leo, and outshines even Regulus by almost a magnitude, so that there can be no difficulty about finding him. Venus is in conjunction with the sun on the 5th, passing

(Concluded on page 595.)

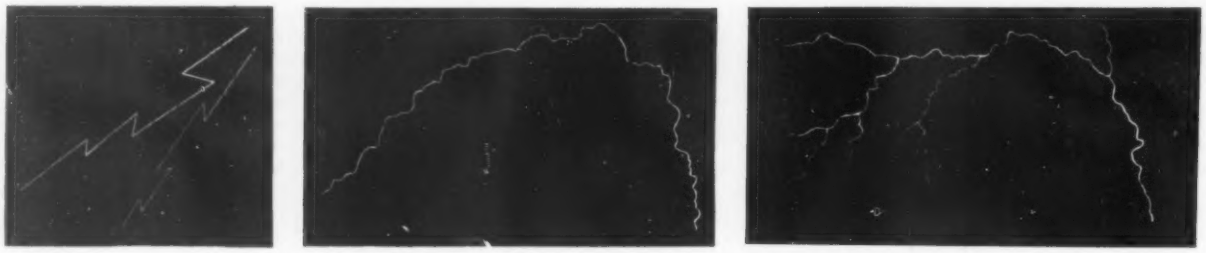
New Ideas About Lightning

A Postscript to the Schoolbooks and Encyclopædias

By C. Fitzhugh Talman

ELEMENTARY text-books still generally follow Arago in classifying the visible electrical discharges of the atmosphere under three distinctive headings: zigzag lightning, sheet lightning, and ball lightning.

The term zigzag lightning is a misnomer, and like other misnomers tends to perpetuate a mistaken idea. In ancient paintings and sculptures the lightnings grasped in the hand of Jove or clutched in the talons of his eagle bristle with sharp angles. Exactly the same kind of lightning is still represented by artists. Arago and his contemporaries firmly believed in angular lightning. Its existence was first denied by James Nasmyth, in 1856, and his contention that so-called zig-zag lightning is really sinuous was soon after confirmed by photography. Nasmyth's drawings illustrating the contrast between the lightning of art and the lightning of nature are reproduced in Fig. 1. The need of reiterating his announcement at this late date is shown by the fact that lightning flashes still zig-zag their way through the drawings of many contemporary illustrators of story books. It is not so long ago that they were definitely banished from the school books.



Artists' Lightning — Natural Lightning

Fig. 1.—Nasmyth's drawings of lightning, real and unreal.
Quarterly Journal of the Royal Meteorological Society

The camera has solved many problems concerning the forms of lightning, but has also raised a number of new ones. The use of a moving camera, which analyzes the lightning flash by revealing its structure at successive moments of time, introduced by Weber and Hoffert in 1889, and further applied by Walter in 1901 and Larsen in 1902 revolutionized our knowledge of this subject. This method has been further improved by Walter during the past two years.[1] He now uses two cameras, installed side by side, one of which is fixed, while the other is turned slowly on a vertical axis by clockwork. Two photographs are thus taken, one of which shows the relative positions of all the flashes occurring within a certain field, while the other analyzes the flashes that have a sensible duration; and a comparison of the two pictures shows the relations in time of the various phases of the phenomenon. (See Fig. 2.)

Briefly stated, the camera has given us the following information in regard to lightning:

Visible lightning is due to the incandescence of the air along the path of an electric discharge—which may be sinuous, spiral or looped (disregarding the sheet and globular forms for the present) and is usually accompanied by numerous branches. The flash as a rule consists of several sparks (i. e., separate discharges) following the same path. Each spark is generally instantaneous, in the ordinary sense of the term (sometimes lasting less than one five-thousandth second, according to Schmidt), but the intervals between the sparks may average one tenth second, so that the total duration of the flash is often half a second or more. These successive discharges along the same path give lightning its flickering appearance.

The electric discharge does not, as a rule, immediately bridge over the whole space between cloud and earth or cloud and cloud. It builds up its path gradually; the electric current feels its way, so to speak. The first feeble discharges extend only part way along the ultimate path, and end as brush discharges in the air. Then comes a sudden and powerful discharge along the whole path. This may completely equalize the potential between the two bodies connected by the flash; or, after a brief pause, a series of discharges may occur along the same path, as described in the preceding paragraph. Some of the remarkable photographs taken by Walter, at Hamburg, show these three classes of phenomena very clearly; and they have been named by this investigator the "preliminary," "primary," and "after" discharges, respectively. ("*Vorentladungen*," "*Anfangsentladung*," "*Nachentladungen*.") The time occupied by the preliminary discharges has been found to vary between 0.001 and 0.02 second. The after-discharges may continue for half a second, or more, as stated above.

In a photograph of a lightning flash made with a camera moved across the direction of the flash so as to reveal its successive phases (see Fig. 2*b*), the successive sparks are usually easy to distinguish, but are not separated by intervals of complete darkness. The whole band has a more or less blurred effect, apparently indicating that the illumination persisted from one spark to the next. Often this glow is stronger at certain points in the path of the discharge than others, so that the moving camera gives the appearance of horizontal striation to the broadened image of the flash.

The true nature of this glow has not yet been settled beyond dispute. The most obvious explanation is that the incandescence of the air persists for a time after the discharge is passed. This explanation was offered by Touchet some years ago, and has been warmly advocated by W. J. S. Lockyer, among others.[2] Those who accept this view call the phenomenon an "afterglow." According to K. E. F. Schmidt[3], the glow is due to phosphorescence. An analogous phenomenon seen in Geissler tubes containing air has recently been similarly explained by Prof. Strutt as a phosphorescent flame, due to the reaction of nitric oxide and ozone formed in the discharge. According to Walter the afterglow has no objective existence. He claims that the horizontal trails seen in the moving-camera photographs are chiefly due to the superposition of those portions of the path of the discharge that run parallel with the motion of the camera. Lastly, we must suppose that the diffuse glows seen about all the brighter features of a lightning photograph are at least partly the result of internal reflections in the camera and other defects in the technique of the photographic process.

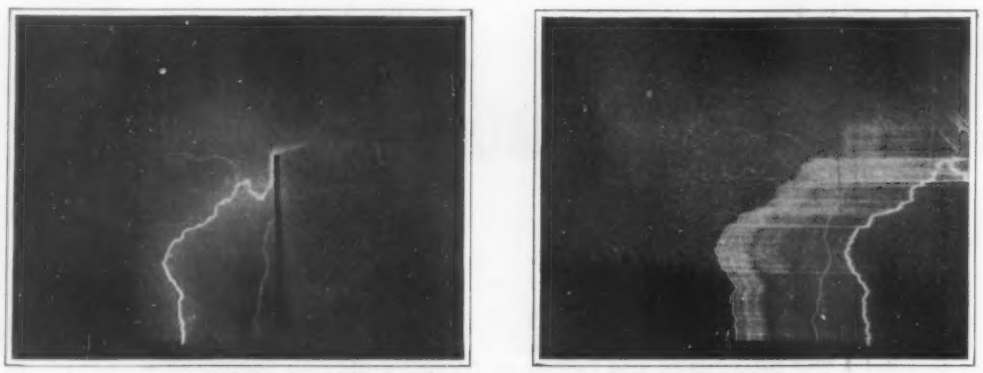


Fig. 2a — Fig. 2b

Fig. 2.—Lightning photograph with double camera.—(Walter.)

a was taken with a stationary, and *b* with a camera moving toward the left, so that the order of the phenomena, in time, proceeds from left to right. The black vertical bar shown distinctly in *a* and faintly in *b* is a distant chimney. The most brilliant flash in *a* is shown in *b* to have been made up of a large number of successive discharges along an identical path; while all the other flashes were sensibly instantaneous.

"Ribbon" lightning is common in lightning photographs; i. e., the photograph very often shows a band, rather than a line of light; but this is, in most cases, simply due to an accidental or intentional movement of the camera transversely to the direction of the flash, or sometimes to the same inherent defects of the camera that account in part for the afterglow. Walter finds that with a perfectly stationary camera the apparent breadth of an average stream of lightning would, if real, indicate that the path was over three feet in diameter. In these cases he believes that the breadth of the path is illusory; the imperfect definition of the objective for bright objects having spread the image as much as tenfold. The same effect is seen in astronomical photographs; the brighter stars appearing on the negative not as points, but as broad disks. The human retina is subject to the same defect; and we may thus account for the frequently reported occurrence of so-called "ribbon" lightning, as seen with the naked eye. In some cases a flash of lightning, as recorded by a stationary camera, or as seen by the eye, may be more or less broadened owing to a lateral shifting by the wind, of the air channel along which the successive discharges occur; but that there should be anything like a *uniform* shifting all along the path of a flash of average length—i. e., several thousand feet—is, in the nature of things, extremely unlikely. The wind effect might cause an irregular thickening or twisting of the image impressed on the photographic plate, or the retina, but hardly anything similar to the tape-like stream of light commonly shown in pictures of so-called ribbon lightning. Lockyer, in the examination of many hundred photographs of lightning, was able to find only one—viz., that made by Kayser, at Berlin, July 16th, 1884—in which some-

[1] B. Walter, "Ueber Doppelaufnahmen von Blitzen," Jahrb. Hamb. Wiss. Anstalten, 27, 1909. 3 Beiheft. Hamburg, 1910.

[2] *Comptes rendus*, 140, 1905, p. 1081.

[3] *Elektrotechn. Zeitschr.*, 26, 1905, p. 900.

thing approaching the ribbon form was registered by an absolutely motionless camera[4]; and even in this case the "ribbon" is so irregular in width as to hardly deserve this name. I think, moreover, it is safe to assume that the flash photographed by Kayser was rather near the camera, so that the portion of it shown in his picture had not a great absolute length.

"Beaded" lightning—also known as "chapleted" or "pearl" lightning—has several times been drawn but

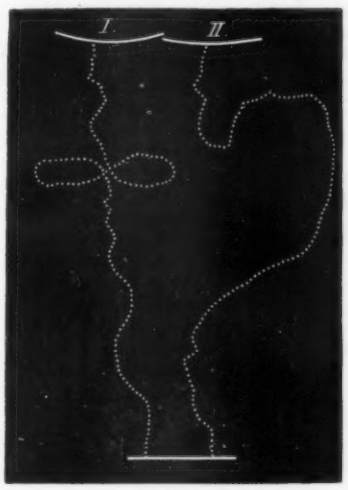


Fig. 3.—Drawing of two flashes of "beaded" lightning.

(After Endemann, *Meteorologische Zeitschrift*, 1888.)

very rarely photographed. It is described as consisting of a series of bright points giving more or less the effect of a string of pearls. (See Fig. 3.) In several cases an ordinary linear flash is said to have resolved itself into this beaded form before fading out of sight. Lockyer[5] thinks that in all cases it is simply a discontinuous afterglow; though, as stated above, the existence of the afterglow has been denied. Photographs with a moving camera appear to show that the afterglow is strongest at the points along a lightning flash where the direction of the flash changes. This is illustrated in Fig. 4. It will be seen that the lateral streaks of light, which are, according to Lockyer, the trails impressed upon the moving photographic plate by the afterglow, are most pronounced at the bends and loops in the path of the discharge. It is evident that if these bright spots persisted long enough after the original flash to be perceptible to the naked eye, they would produce exactly the effect described as beaded lightning. Unfortunately, this phenomenon has been rarely observed, and we are not able to say positively whether the "beads" sometimes appear without a previous continuous flash, in which case we should have to seek another explanation. It may be that in some cases what is seen is simply several portions of a continuous flash visible through interstices in the clouds. "Stellar" lightning (often seen in connection with volcanic eruptions) is explained by Prinz as probably an effect of perspective. Suppose the branching flash shown in Fig. 6 to be seen by an observer at either *A* or *B*, i. e., in the line of the flash. It will present the appearance shown in Fig. 5.

"Black" lightning—a common feature of lightning photographs, generally in connection with ordinary bright flashes—is often explained as a reversal due to over-exposure. (See SCIENTIFIC AMERICAN, 1910, p. 463.) This explanation hardly seems to account for the fact that the small, and presumably relatively faint, lateral branches of a bright flash are so often of this character. Since the discovery by A. W. Clayden, in 1889, of what is now known as the "Clayden effect," it has been generally believed that after relatively faint flashes have been impressed on the plate, a subsequent general illumination of the field by light reflected from clouds causes these flashes to print dark, or under some conditions to be entirely obliterated.[6]

"Sheet" lightning is the name applied to diffuse, and usually noiseless discharges. Common usage extends this term to include diffuse reflections of ordinary linear discharges, which are themselves hidden by clouds or below the horizon; especially the "heat" lightning that plays along the horizon on summer evenings, and is merely the reflection of a thunderstorm too far distant to be audible. It is a mistake, however, to suppose that sheet lightning is always the effect of a diffuse reflection; the electric discharge itself sometimes takes a sheet-like form, and an analogous phenomenon is the glowing of so-called "incandescent" or self-luminous clouds, the occurrence of which is probably much commoner than is generally supposed.[7]

"Ball" lightning is still a baffling subject, and we cannot here enter into the many speculations concerning it. There is, indeed, considerable doubt as to the propriety of regarding this luminous meteor as a form of lightning, in the ordinary sense of the term.

The Cause of Lightning.

It is doubtful whether any other discovery in the whole history of science has wrought so many changes in conceptions deemed fundamental and irrefragable as has that of ions and the phenomena connected therewith. In the light of the knowledge acquired during the past decade the science of electricity needs to be, but has not been, rewritten; and to-day physicists, in dealing with this subject, are using a terminology based upon obsolete notions, and therefore often extremely misleading.

Without, however, attempting to set forth the modifications that the new views concerning the nature of electricity have brought about in every branch of atmospheric electricity, and without attempting a rigid definition of the terms employed, let us consider for a moment the hypothesis now most plausibly advanced to account for the fact that, at certain times, the potential gradient of the atmosphere becomes so great that the resistance of the air is broken down, and an electrical discharge occurs. This hypothesis is a little over two years old, and is due to a brilliant young English physicist, George Simpson, attached to the meteorological service of the Government of India.[8]

Simpson's hypothesis is based upon the fact, well attested by laboratory experiments, that the breaking up of drops of water involves a separation of positive from negative electricity; in other words, a production of both positive and negative ions. In this process the drops become positively charged; i. e., they retain a greater number of positive than of negative ions, the latter being set free in the air. About three times as many negative as positive ions are thus released.

Now a thunderstorm is accompanied by a strong upward movement of the air; so strong that small drops cannot fall through it, while large drops, which would be heavy enough to fall through such a vertical current if they could retain their integrity, are broken up by the air and then carried aloft, where they tend to accumulate, recombine and fall again. This process may be repeated over and over again, so that the positive charge of the drops is continually increasing, and at the same time negative ions are being set free, which are carried by the ascending air current to the upper part of the cloud, where they unite with the cloud particles and give them a strong negative charge. Thus a continuous separation of electricity is in progress. Ultimately the positively charged drops accumulate to such an extent, or they reach a place where the updraft is so weakened that they fall as positively charged rain, leaving the cloud strongly charged with negative electricity.

According to this hypothesis the heavy rain of a thunderstorm should be positively charged, and that such is the case was shown by extensive observations made by Simpson in India. However, within the highly electrified cloud there must be a rapid combination of the negatively charged water drops, which would fall as a more gentle rain; and this assumption is also confirmed by observation. Simpson's hypothesis may be said to have supplanted that of Wilson and Gerdien, according to which the separation of the positive from the negative ions was due to the fact that the latter more readily become the nuclei of aqueous condensation. It was supposed that, in an ascending air current, the dust was sifted out by condensation upon it in the lower strata; as the air, thus freed of its dust, continued to rise, it was cooled until it had reached such a degree of supersaturation that condensation could occur upon the negative ions, which would thus be sifted out in their turn. The objections raised to this hypothesis are chiefly quantitative rather than qualitative, and it is still an open question whether it may or may not account in part for the potential gradients observed in the atmosphere.

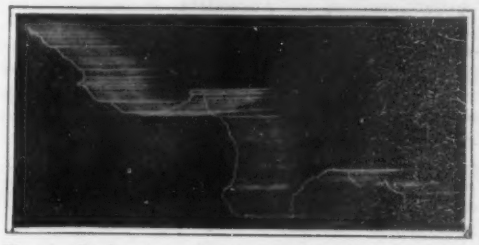


Fig. 4.—Lockyer's explanation of "beaded" lightning.

(Photograph by Walter.)

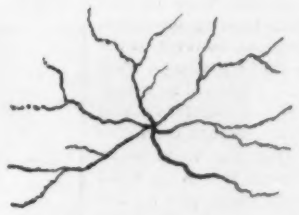


Fig. 5.—"Stellar" lightning.

(After Prinz.)

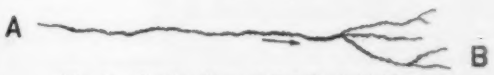


Fig. 6.—Explanation of "stellar" lightning.

(After Prinz.)

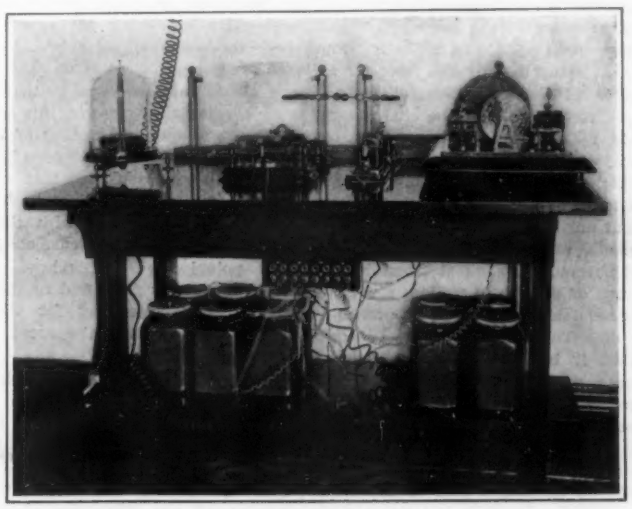


Fig. 7.—Odenbach's ceraunograph as installed at St. Ignatius College Observatory, Cleveland, Ohio.

This instrument formerly recorded thunderstorms as far distant as Fort Smith, Ark. Since wireless telegraph stations have been installed at Cleveland this range is much reduced, but the inventor is now at work on a device to cut out the wireless. On the table are seen two sets of receiving apparatus, one with a 1,000-ohm relay, the other 150 ohms, each with a sounder serving as a decoherer. To the left is a galvanometer which indicates the amount of current passing over the coherer. The recording apparatus is shown on the right.

Lightning Recorders.

Even a hasty survey of recent progress in the study of lightning should take note of the ingenious use of the methods of wireless telegraphy in observing and recording electrical discharges in the atmosphere.

A flash of lightning sets up electromagnetic waves in the ether. These may be received, at great distances from their source, by a suitable antenna, and sent through a coherer (using this term in the generic sense), which thus becomes conducting to a galvanic current; the latter actuates a relay, which closes a secondary circuit, and brings into play the recording apparatus, which is usually a pen tracing a record on a revolving drum. The forms of lightning recorder that thus make a continuous registration on a sheet of paper are called generically *ceraunographs* (a term introduced by Odenbach in 1891). Several forms of the ceraunograph have been devised by Boggio-Lera, Fenyi, Schreiber, Lancetta, Odenbach, Garcia Mollà and others. Their radius of action is several hundred miles. By the use of several relays Boggio-Lera and Turpain have produced instruments that record not only the occurrence, but also approximately the distance, of an electrical discharge. There are also thunderstorm recorders that make an audible record, by ringing a bell or otherwise. In the ingenious instrument invented by Tommasina—known as the *electro-radiophone* or *ceraunophone*—the observer uses a telephone receiver, whereby he is enabled to listen to a thunderstorm far beyond the range of the unaided ear, and to gain some idea of the movement of the storm by noting the variations in the intensity of the sound.

[4] *Knowledge*, n. s. 5, 1908, p. 118.
[5] *Knowledge*, n. s. 4, 1907, pp. 146-147.
[6] *Phil. Mag.*, 5th ser., 28, 1889, p. 92.
[7] *Meteorologische Zeitschrift*, 17, 1900, pp. 448-457; *Monthly Weather Review*, 29, 1901, p. 466.
[8] Proc. Roy. Soc., ser. A, 82, 1909, p. 169, *ffg.*

Inventions New and Interesting

Simple Patent Law; Patent Office News; What Inventors Are Doing

The New Navy Gyroscopic Compass

THE fact that the magnetic compass does not point north has been generally well understood. As a matter of fact, however, mariners have always known to their sorrow that the "fidelity of the needle to the pole" is nothing more than a poor, weak tendency to point somewhere near a constantly shifting spot a thousand miles from the true pole. When the needle can find an excuse for pointing somewhere else it never fails to do so, and its untrustworthiness and vagaries are the cause of constant anxiety to every navigator.

Not so general, however, is the knowledge that a gyroscope when employed on shipboard as a compass also points a devious course and requires constant correction involving some four variables including, strange to say, the speed of the vessel itself—and all this before the true north is found with any exactitude. This fact will be received with no little surprise, as we have always been taught that if the gyroscopic compass could ever be made practical, we should be in possession of an absolutely reliable indicator of the true north.

In the United States navy new gyroscopic compass, however, for the first time in the history of navigation, we have a compass which, under all conditions of service, constantly holds exactly true to the geographical meridian, requiring no correction factors and no correction tables. This compass overcomes all of the difficulties heretofore encountered and constitutes a precision instrument of the highest accuracy, thus meeting the exacting requirements of the Bureau of Navigation of our navy, whose headquarters are in the Naval Observatory at Washington. This bureau for many years has pursued elaborate investigations along all possible lines giving promise of overcoming the growing difficulties with the magnetic compass. It was through the research by Mr. Elmer A. Sperry, of New York, intimately associated with the pioneer electrical development of this country, that the results were finally achieved.

These compasses are now in use upon the "Delaware," "Florida," "North Dakota," "Utah," "Michigan" and other of the largest battleships, as well as on the larger submarines.

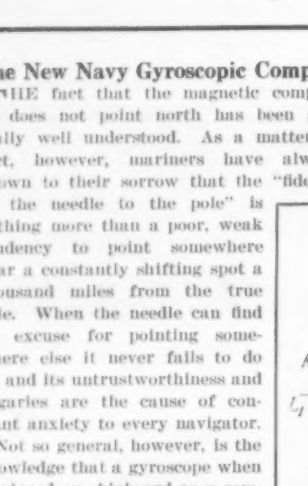


Fig. 1.—Master compass binnacle casing lowered.

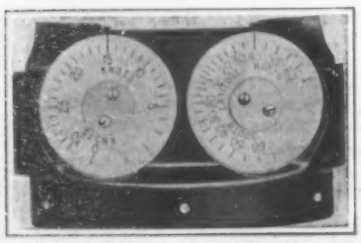


Fig. 5.—Automatic correction device, setting 15 knots, 40° north.

The master compass is shown in Fig. 1, with the under case lowered, showing the relative position of the gyro wheel, casing, etc.

Since the earth's magnetism has not the slightest effect upon the new compass, the question arises: What force it is that is depended upon to produce its great north-seeking power—some 300 times that of the standard magnetic compass? The force is the rotation of the earth upon its axis, and the wonder is that apparatus could be devised which could be made to respond to so subtle an influence, amounting to an extremely small fraction of a single unit of angular motion.

The underlying principle upon which the gyroscopic compass depends for its operation is very simple and easily understood. No mathematical treatise is necessary to its full comprehension.

The principle may be stated as follows: Any mass when set in motion is found to follow laws differing radically from those that apply to bodies at rest; for instance, a spinning wheel may be moved in any direction without the slightest resistance, response or reaction, so long as the trajectory or line of movement is straight; but let it be other than straight, for instance, in a curved or circular path, or about any point or axis, either nearby or remote, and at once new and unexpected phenomena manifest themselves in the form of automatic motion, especially if the revolving body is free to move in other directions than its spin. We thus see that it is angular motion and not unilinear motion that causes these responses, which are known as gyroscopic precession.

To illustrate further this principle: Imagine an observer out in space looking directly at the south pole of the earth. He would at once notice it turning clockwise upon an axis which pointed directly toward him. Now suppose he could also see a number of gyro-compasses, no matter where they were located upon its surface, he would notice that as soon as they were set spinning they would start orientating, and when finally settled the axis of the spinning wheel of each of them would be pointed toward him, and the direction of the spin of each would be exactly the same as that of the earth, namely, clockwise.

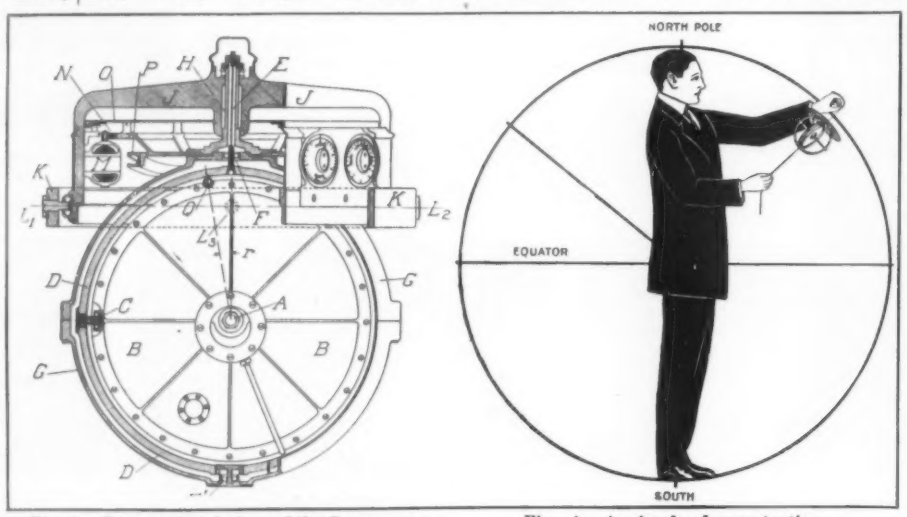


Fig. 3.—Part-sectional view of the Sperry gyro-compass, showing the system of mounting.

Fig. 4.—A simple demonstration of the action of a gyro-compass.

The principle which makes the gyro-compass possible may readily be demonstrated with an ordinary toy gyroscope top. The interest is enhanced by fitting a card upon the little ring of the gyro top and marking upon it the four cardinal points, as shown in Fig. 2. Fasten to the wire frame of your gyroscope at opposite points and at right angles to the axis of the little wheel, short pieces of string. These toys, of course, are much too crude to be affected by the earth's rotation, the axis of which is some four thousand miles away. For this reason the axes of these tops do not point north and south, parallel to the axis of the earth.

When, however, the little gyroscope is acted upon from the more immediate axis of a smaller rotating body, the principle is beautifully illustrated. Such a body is furnished when the observer holds one of these little gyroscopes in his hand and rotates on his heel, as indicated in Fig. 3; the observer thus becomes an artificial earth, and when rotating to the left his head becomes the north pole and his feet the south pole. The surface of this artificial earth or imaginary sphere is shown by the curved lines in Fig. 3, of which the head and feet comprise the respective poles. By stretching his arms out at about the center of his height, he places the gyroscope at a point on this imaginary sphere corresponding to that of the earth's equator. By raising his arms the gyroscope follows the contour of this imaginary sphere into its northern latitudes.

It should be remembered that when the observer rotates from *right to left* (see Fig. 2), the similitude with the earth rotating eastwardly is correct for the north pole located at his head and the south pole at his feet; and rotating from *left to right* is correct for the south pole at his head and the north pole at his feet.

Hold the pieces of string taut, one in each hand, with the string in line of radius of the imaginary sphere, as illustrated in Fig. 3. If, then, while thus holding the gyroscope in a position corresponding to any point on the earth's surface except the poles, the observer rotates on his heels in the fashion in which the earth rotates, the north of the compass card or the axis of the gyroscope will remain pointing with entire indifference, whether you rotate from right to left or from left to right, unless the top is spinning.

Immediately the gyroscope is set in motion, however, the result is different. Now, as the observer rotates in one direction the one pole on the card comes uppermost and remains so (see Fig. 2), while as soon as he rotates in the opposite direction—thus in effect turning your artificial earth upside down—the uppermost pole immediately flops over and points to the observer's feet instead of his head. The law of the gyroscope has acted and the compass has followed the pole. Every time this reversal is made and the pole is changed from the bottom to the top of the sphere the little gyro-compass, following the pole, will be seen to turn on the instant, with an energy which is not only interesting but quite surprising. While this observation is simple, the action is so vigorous as to make a lasting impression upon the observer.

The general arrangement of parts constituting the Sperry gyro-compass is shown in Fig. 4, which for greater clearness in illustrating the various functions has been simplified by the omission of electrical circuits and minor details.

The gyroscope wheel is mounted to rotate on a horizontal shaft *A* within the casing *B*, which is pivoted on the horizontal axis *C* through its center of gravity and is carried by the frame or vertical ring *D*. The ring *D* is suspended by a torsionless strand *E* and guided by bearings *F* and *F*¹ to allow a free oscillation of a limited amount about its vertical axis within the frame or phantom *G*. The phantom *G* has a hollow stem *H*, to which the strand *E* is attached at its upper end, and the stem forms a journal for rotation in azimuth with respect to the supporting base frame *J*.

The frame *J* is mounted to swing in the binnacle by the usual Cardan suspension, consisting of the ring *K* and suitable bearings *L*-1, *L*-2, *L*-3, and *L*-4—the latter not shown.

The frame *J* carries a "follow up" motor *M*, driving a master gear *N*, forming a rigid part of the phantom *G*, whereby the latter is positively driven in azimuth to respond to any movement of the ring *D*.

The power-driven phantom *G* is automatically controlled, so as to respond instantly to all movements of the sensitive element, and, in fact, to all relative movements in azimuth between the ship and the gyro.

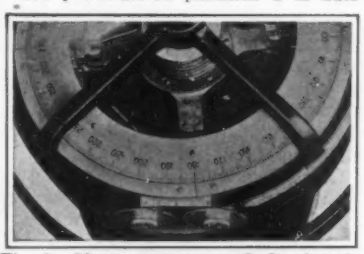


Fig. 6.—Master compass card, showing the exact meridional course and the amount of correction automatically introduced.

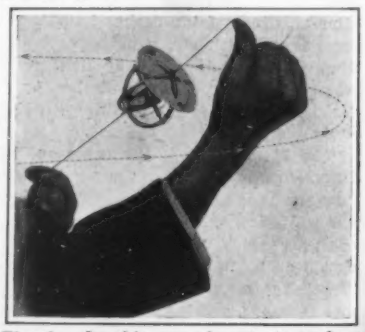


Fig. 2.—In this experiment, turn from right to left, and north on the gyro-top will point up.

This characteristic of the phantom enables it to be used for various important functions, namely: to carry the scale or card *O* and a cam *P* forming a part of the automatic correcting device, to be later described.

Since the phantom, though at all times rigidly anchored to the binnacle, stands practically in constant relation to the sensitive element as regards motion about the vertical axis, but is nevertheless entirely separate therefrom, it serves as an anchorage for producing stresses to restrain and correct the movements of the sensitive element. This is accomplished by means of a yielding connection or springs *Q-Q* between the phantom *G* and the gyro case B.

Government tests of the gyro-compass disclose many interesting and distinctive features:

The compass receives its directive power as an effect of the earth's rotation and gravity acting on the spinning wheel. The wheel revolves in a vacuum at approximately 8500 revolutions per minute. A directive power is developed which amounts to practically 204,000 dyne centimeters, when in the east-west position at the equator. These values have been checked up by actual observations and tests of the directive power under service conditions made by representatives of the United States Navy and engineers of the Sperry Gyroscope Company. The greatest directive power of any gyro-compass so far recorded is 20,190 dyne centimeters, or less than 1/10 that of the Sperry gyro-compass as determined by these findings.

THE AUTOMATIC CORRECTION FEATURE.—The gyroscopic compass on moving ships *does not* point north as has been supposed, but constantly requires the introduction of some three positive or negative correction factors, before one can ascertain the true location of the meridian. On land a gyro-compass will point to the absolute north, but when it is mounted upon a moving body, a ship, for instance, which has a northerly or southerly course, the gyroscope no longer receives simple easterly motion (from the earth's rotation) but a mixed motion, and is accordingly deflected from the meridian to correspond with the new relative axis in space. The amount of this correction depends upon three variables, namely, the course of the ship, the speed upon such course and the latitude. The latitude also introduces a second correction, due to certain characteristics of the compass.

Heretofore it has been necessary to make simultaneous readings of these three independent factors and compute the total correction, or else consult elaborate printed tables to determine the positive or negative correction necessary in ascertaining the position of the meridian. It has also been necessary in some cases to make various adjustments by the addition or removal of weights with changes of latitude. Mr. Sperry has produced an automatic correction apparatus, constituting a simple part of the compass structure, by means of which all of the above components of deflection are compensated for and automatically entered, so that all readings of the master compass, together with the repeating compasses and other auxiliary apparatus are always held dead upon the meridian. The indication of each repeater located at remote parts of the ship is always held true and found to read exactly upon the sun without any of the troublesome correcting factors mentioned above. This automatic correction device shown in Fig 5, mechanically solves the above formula and does away completely with the necessity of consulting charts or tables or making computations for determining true direction as has been heretofore necessary. The amount of correction being introduced at any moment may be read upon the little scale outside the back lubbers line, see Fig. 6, which shows a part of the compass card from the helmsman's position.

The suspension of the sensitive element is entirely mechanical and consists of one or more strands of fine piano wire of very high tensile strength and resiliency. By doing away with the mercury floats for sustaining the rotating parts all changes in mechanical and chemical behavior, viscosity and other evils attending the use of mercury are avoided; this also does away with the observed and very serious swirling disturbances, which, without warning, drag the card around from its true bearing in rough and stormy seas.

Artificial orientation, coupled with the unique device which indicates when the compass is exactly on the meridian, promotes accuracy and quick setting.

The gyro wheel of the Sperry compass operates in a vacuum, which effects a very material saving in the driving power required, and also possesses the further advantage of maintaining effective speeds for a considerable period after any cessation of the power supply, due to accident. On some of the earlier sea trials, where the current was cut off, accidently, for periods up to three-quarters of an hour, the speed was not diminished sufficiently to interfere with the directive power of the instrument. With the same wheel running in air, and especially with air ejection, more than *ten* times the power will be required. On the other hand, should the power supply fail, the speed would decrease, especially at the start, fully *twenty* times as rapidly as with vacuum operation.

The secondary transmission system comprises: A master compass located in the hold of a ship wherever convenient; a transmitter operated by and forming a part of the master compass; various forms of repeating compasses, controlled by the transmitter, but located at different points about the ship, and switchboards with instruments for synchronizing and controlling the distant instruments.

Upon the synchronizer and distributing panel are indicators, one for each repeating instrument, so that the officer responsible for the compass at the central station can always see at a glance that each repeater compass which is coupled with the system is functioning properly.

Not only is there an entire absence of variation and deviation in this gyro-compass, but extended experience at sea shows that the heaviest gunfire has no effect on the instruments and that there is no heeling error even in the heaviest rolling, this being true for all headings.

Notes for Inventors

An Ingenious Weather-cock.—A friend of ours has a cottage in Maine and has applied an ingenious weather-cock which indicates the direction of the wind. This is at the top of his house and he realizes the necessity or desirability of some means for transferring the indication from the weather-cock above to the living room below. He thinks it can be effected by means of an indicator in the living room operated electrically in connection with a compass so that at a glance the direction of the wind can be read in the living room. He has not yet been able to work out satisfactory electro magnets for controlling the compass in the living room by the movements of the weather-cock. This offers an opportunity for inventors as doubtless a conveniently installed apparatus of the character indicate would prove profitable to the successful inventor.

Needed: A Dress Shield Fastener.—Why does not some one invent a simple, effective device for fastening dress shields in dresses. They should be easily applied to the shield so they can be readily removed for application to another shield when desired, should avoid any perforation of the shield and should connect with the body or sleeve of the dress in such manner that they will not be seen even when used with the lightest lingerie dresses.

An English Locomotive Improvement.—Thomas H. Brigg of Goldstone, England, has patented, No. 1,027,810, a railway locomotive in which the boiler, tender and cab between them are so connected to each other and to a supporting frame as to form an unusually long rigid structure with front and rear pivotal trucks, the rear one of which is fitted with driving mechanism.

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Charles D. Sigsbee
Rear Admiral, U. S. Navy, writes:
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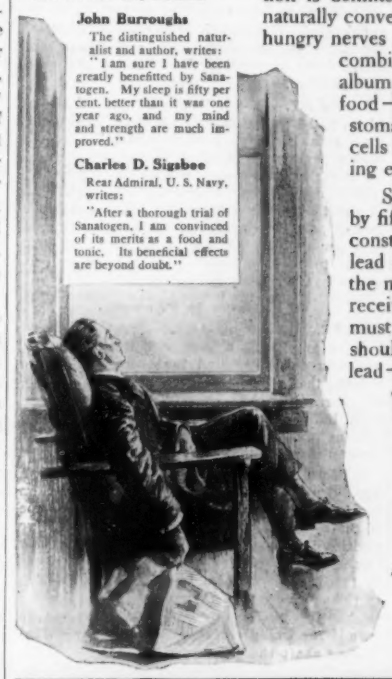

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RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

ELECTRO-MAGNETIC APPARATUS.—J. MCINTYRE, 23 Claremont Ave., Jersey City, N. J. This invention relates to Ruhmkorff coils and similar apparatus, and provides an apparatus arranged to increase the speed and force of the vibratory armature, and to insure an uninterrupted response of the armature for a long period without the danger of the armature sticking at the contacts.

HAIR STEAMING DEVICE.—T. GROSERT and E. UNGER, care of E. Unger, 465 Greenwich St., New York, N. Y. The objects of this invention are attained by disposing a coil of hair within one of a pair of concentric tubes, between which tubes is disposed a resistance to electric energy, by means of which the tubes are heated. Suitable heat-insulating material surrounds the working parts, and means are afforded for suspending the device in any suitable position.

TROLLEY.—J. H. WALKER, care of J. R. Allen, 810 Trust Company Building, Lexington, Ky. This invention relates especially to the spring devices for holding up the trolley pole for electric cars in such manner as to press its trolley against the conductor wire; and the aim is to provide a form of tension spring for trolley poles in the nature of a flat spring, as well as to provide means of securing said spring to the pivot pin of the pole as well as at the base plate of the turn-table.

Of Interest to Farmers.

GATE.—R. MOORE, Adena, Ohio. An object here is to provide a gate which will not sag, which is so constructed that when closed the weight thereof is borne by both gate posts, which requires but simple manipulation to unlatch it, which necessitates but slight effort in opening and shutting it, and which produces no undue strain upon the posts.

WING CARRIER.—W. F. BROWN, 5207 Penn Ave., South Minneapolis, Minn. This invention provides means for, at will, varying the shape of the carrier without alternating the operative position of the same; provides supporting means for the carrier adapted for employment on threshing machine and arranged to conform to the structure thereof, and provides a driving mechanism having an extensible member to permit the swing of the carrier relative to the driving shaft therefor.

MOLDBOARD PLOWING MACHINE.—W. G. PARMELE, Chetopa, Kan. This inventor provides a power-driven traction mechanism arranged to track in the furrow formed by the plow; provides means connected with the tractor for leveling the operation and regulating the depth of the plow; and provides a tractor and moldboard plow connected therewith for normally forcing the plow through the earth, without varying the depth of operation of the plow.

STACKER.—O. L. WAGGONER, Latham, Kan. The present type of stacker has a framework mounted upon wheels and carrying a rake head, the parts being so mounted and arranged that the rear wheels may be moved forward rapidly in relation to the front wheels, thus causing a part of the framework to bow or rise upwardly, carrying with it the rake head so as to elevate the rake head to any desired height within reasonable limits and thus facilitate the discharge of the hay at any desired level.

Of General Interest.

DRINKING CUP HOLDER.—C. A. BRYANT, Passaic, N. J. This improvement provides a holder more especially designed for holding a large number of superimposed flat drinking cups of paraffin paper or like material, and for permitting convenient removal one by one of the cups as required for use by persons at public drinking fountains and other water supplies.

PERPETUAL CALENDAR.—J. J. O'BRIEN, 174 Fifth Ave., Manhattan, N. Y. This calendar is arranged to disclose the name of the month, week days and days of the month, to permit convenient setting at the end of each month for correctly displaying the days for the next month, and to indicate the past days of the month and the present day of the week or month.

NON-REFILLABLE BOTTLE.—A. DRYFOOS, 42 W. Broadway, Manhattan, N. Y. The purpose in this case is to provide a non-refillable bottle, arranged to permit ready pouring of the contents of the bottle into a glass or other receiving receptacle, and to prevent refilling of the bottle, after the same is once emptied, with spurious goods by unauthorized persons.

Hardware and Tools.

SCALE SCOOP.—F. H. MARTIN, 417 Precita Ave., San Francisco, Cal. The object of this invention is to provide a scale scoop having means thereon adapted to contain a quantity of material, other means being provided whereby when the scoop is held in vertical position, the mass of material contained therein may be indicated.

FAUCET.—H. FORSMAN, 618½ W. 6th St., Los Angeles, Cal. The faucet is so constructed that the fluid may be drawn from the tank without supplying additional fluid to the tank, or when occasion requires fluid may be supplied to the tank, without drawing any fluid therefrom. It is also possible to regulate the amount of fluid supplied to the tank relatively to the amount of fluid drawn therefrom during the stated period.

SAD IRON.—A. E. ABBOTT, Box 55 C., R. R. 2, Compton, Cal. This invention provides an efficient sad iron, or self-heating flat iron, for use in smoothing linen, in laundering, etc., which is compact in form, in which liquid fuel or the like can be employed for heating the iron, in which the amount of heat desired can be exactly regulated, which is economical in use of fuel, and in which the parts are removably assembled, so that the iron can be taken apart and put together, for the purpose of cleaning it or for repairing or replacing parts.

Heating and Lighting.

METHOD OF MAKING HEAT INSULATED RECEPTACLES.—R. HARTWIG, No. 12 Bregenzerstrasse, Berlin, Germany. This method uses a bottomless cylindrical shell with an annular flange. The former is placed flange downward and a jointing device laid on the flange. An inner vessel is inserted bottom upward into the cylindrical shell. The annular flange of the inner vessel comes into contact with the jointing ring and there is no direct contact between the two vessels. Space between these is rammed tight up to the level of the bottom of the inner vessel with asbestos, glass wool, ground cork, etc. Means provide that the inner vessel is pressed with its flange upon the above material. A layer of this is spread upon the bottom of the inner vessel and rammed tight, whereupon the bottom of the shell is pressed down hard upon the material and soldered in place.

RADIATOR.—F. SCHNEIDER, care of G. F. Weller, Memphis Bread Co., Box 413, Memphis, Tenn. This radiator is arranged to insure a rapid circulation of steam, water or other fluid heating medium employed under desired pressure, to dispense with the use of air valves or vents and avoid leakage, to prevent the escape of bad air from the radiator into the room in which the radiator is located, and to prevent hammering.

Machines and Mechanical Devices.

VALVE.—N. B. CREIGHTON and S. BLOCK, care of N. B. Creighton, 134 Perry St., Maspeth, N. Y. The object of the present invention is to provide a valve arranged to normally hold the valve in an open position for the passage of gas, liquid or other fluid, to allow of releasing the valve from a distant point whenever it is desired to close the valve, and to allow the valve to close automatically in case of fire. Messrs. Creighton and Block have invented another valve in which the object of the improvement is to provide a valve arranged to normally hold the valve disk in an open position for the passage of gas, liquid or other fluid, to cause the valve to close automatically in case of fire and to allow closing of the valve from a distant point.

UNIVERSAL SHEAVE SUSPENSION.—VOLNEY W. MASON, Providence, R. I. Mr. Mason's invention relates generally to suspension means for sheaves and more particularly it involves such a mechanism which is particularly adapted for use in elevator shafts. An object is to provide a device of this class which may adapt itself to the different angles in which the cable lies as the cable is wound on a drum during the lifting of the car.

Railways and Their Accessories.

FLOAT RAIL LOCK.—G. W. CLEMMONS, 82 Bloomfield St., Hoboken, N. J. This improvement relates to means for locking a car float to a floating bridge. An object is to provide a lock which will maintain the tracks on the float and the tracks on the bridge in alignment, but will, at the same time, permit a slight play between the float and the bridge.

LINER FOR USE IN FIXING SCREW SPIKES IN RAILWAY SLEEPERS.—G. LAKHOVSKY, 5 Avenue du Bois de Boulogne, Paris, France. This device insures the perfect fixing of the spike, since in the liner, after the spike has been screwed, is pressed forcibly throughout its height against the body of the latter and that by its downwardly flared shape, and by its increasing projections it cannot be displaced in the sleeper.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 9260.—Want addresses of parties able to ship corundum, garnet, flint, emery or any material suitable as an abrasive.

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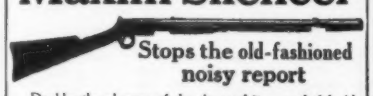

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The Galveston Causeway

(Concluded from page 581.)

ware sewer pipe, the end of which is coveverd with glaze as a protection against the entrance of vermin. The slanting concrete slabs which protect the roadway portion of the causeway are six inches thick, and were cast on the filling after it had been graded and wet down. The joints between slabs are water-proofed with strips of tarred felt.

Not estimated in the length of the causeway, the so-called unprotected roadway portions comprise the mainland and island approaches to the structure. These are graded roadways 119 feet wide at the top, with the slopes on each side sodded heavily with Bermuda grass.

The first spadeful of earth turned in the construction of the causeway was on July 21st, 1909, when work was begun on the $100,000 construction camp at Virginia Point, which included housing facilities, dining hall, various shops, switching tracks, and a 1,500-foot pier for loading and unloading barges. The first work on the causeway proper came September 18th, 1909, when the first coffer-dam was sunk at the site of one of the arch bridge piers.

Prior to the opening of the causeway, the sole means of entry to the city, otherwise than by water-craft, was the old Santa Fé wooden trestle, with one track of sixty-one-pound rail. The Santa Fé received $100,000 in compensation for the loss of revenue when the causeway opened, with the privilege of salving the old structure, which brought in about $60,000 more. All automobiles were formerly brought into the city by freight, or ferried across the bay on barges from Texas City. The opening of the causeway threw open to Texas automobilists the thirty-mile beach speedway of hard-packed sand that rivals Ormond Beach.

Another important economic effect has followed the opening of the county highway across the causeway. The city commission has decided to install on the ground floor of City Hall a public market at which the truck farmers of Galveston County can dispose of their products direct to the people, charging a nominal rental for the use of stalls. For the first time since the storm of 1900 the farmers are now able to drive their wagons direct from the mainland into the city.

Estimated above all other material advantages, however, is the feeling in Galveston and among all who know the city, that whatever tropical storms may brew on the Gulf of Mexico, not only is the city amply protected by seawall and grade raising, but at all times uninterrupted ingress and egress is certain. Never again is Galveston to be cut off from instant communication with the rest of the world.

A Journey in a Zeppelin Airship

(Concluded from page 580.)

the ground before it ascends. While these men cluster around the cars, the friends of the passengers within crowd below the cabin and call out their greetings. Presently there comes the wail of a siren. Everybody is asked to stand back. The light stairway of aluminium is folded and withdrawn into the ship. The men around the cars distribute themselves more evenly along the hull, each seizing a rope as he does so. Another blast of the siren. The great portals in front quiver and groan. With a mighty rumbling they slowly move apart, and open on a vista of grass and dimly outlined roofs, in the distance. A third blast. The airship begins to stir. It is for all the world like the beginning of a steamship voyage. The motion is so slow that those in the cabin have to look hard at the steel girders along the high side walls of the shed (quite suggestive of the side of a steamer's dock) to know whether they are moving or whether they are still at rest. There are no puffing tugboats, but the men along the hull take the ropes over their shoulders, and digging their heels into the ground, pull with might and main on the mass of twenty tons, to move it forward.

The ship moves as if by magic in a straight line, always at the same level and never approaching the side of the shed. As the ship half protrudes into the open and the windows of the cabin clear the great doors, it is seen that there are rails so far apart that, lying as they do very near the shed's sides, they are not perceived within doors. In the open, however, they are very conspicuous; for they are raised fully a foot above the ground. They are of a strange hollow shape. On these tracks peculiar tiny trucks run. Because they resemble cats running along the top of a fence, the Germans call them *Laufkatzen*. Small rollers grip the hollow of each rail on both sides; steel cables run from the ship's hull to the frames into which these rollers are set. Hence the airship is really moving on an inverted track. Buoyed up, it pulls from above at the guiding rails.

The ship leaves the shed just as an ocean liner leaves her berth. But at this stage a very delicate operation must be performed, which finds no counterpart in the water. A steamer regulates her own flotation. An airship has no such way of automatically regulating her lift. On the contrary, changes in the temperature of the gas (the temperature necessarily varies with exposure to the sun) varies the lift. Before the airship can cast loose it is absolutely indispensable that the lift of the gas be nicely adjusted to the weight of the passengers by adding ballast or by taking it away. The color and length of the grass at this part of the rail bear witness to its frequent wetting. Hydrant and hose are again brought into play, until the ship sinks lightly to the ground. Then water is carefully drained off until the vessel rises with just the proper force. More is allowed to flow out from the bow, so that the hull is slightly inclined upwardly.

This is the psychological moment. Another great roar of the motors. The men along the hull drop the ropes and retire. A final blast of the siren and the ship is released from the tracks and the rails. Very slowly the immense structure, bow first, floats up from the ground. When the clutches are thrown in, the propellers begin to turn, at first hesitatingly, but soon to become transparent disks. The motion of the ship steadies itself at once, although it is still very slow. Nothing in a big airship is so reminiscent of an ocean liner as the slow start. The ship at first seems to walk away. But it gathers headway rapidly. f you have looked away for a moment and then back, you will marvel at the increase in speed.

In the cabin the situation is very similar to that on board a steamer after Coney Island has been passed and the real invigorating sea breeze begins to sweep the decks. Although the air in the shed was far from being stuffy or tainted with odors that are typical of the New York wharf yet the change to the absolute clarity and purity of the air five hundred meters above the ground is just as startling as the change from city air to sea air.

The cabin itself reminds one very much of a steamer. The decorative panels of inlaid wood, enveloping stout metal members, hardly give one that impression of flimsiness which is inseparable in the popular mind from an airship. The large windows of an incombustible compound of cellulose are drawn up and through them the upper air of the atmosphere sweeps as a moderate breeze from ahead. The comfortable wicker arm chairs are suggestive enough of steamer chairs.

Far and wide below the ship stretches a misty plain, suggesting the ocean. In the heart of it is a gleam of real water, the river Main, flowing into the Rhine, which it nearly equals in imposing width. To the north is a blue "coastline," the precipitous Taunus Mountains, the nearest peaks of which loom up like capes.

Over the plain the airship seems motionless to the passengers within the

Capillary Attraction Keeps the Parker From Leaking

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cabin. Now that it has come closer to the mountains it seems to sway in a stately rhythm. Each oscillation is followed by a more pronounced roar of the engines. Proximity of mountains means gusts even on a calm day.

The ship speeds so fast that it soon approaches the northwestern bay of the lake-like plain, where another chain of mountains looms up from the west, compelling the Rhine to make a second turn to the north and forming the famous entrance of the deep Rhine valley. Two old castles on opposite sides guard the entrance near Bingen. More significant to the navigators on the airship is an ancient tower, rising from an island in the Rhine just at the middle of the entrance. It was built in the middle ages to collect duty from passing vessels; now it serves as a signal station to ships passing the dangerous rapids of the Bingor Loch, just below. Since airships run through the Rhine Valley, it has become a kind of beacon.

The entrance of the airship into the Rhine valley is dramatic. From about the level of the old castles, those within the cabin not only see charms which are famous all over the world but look deep into lovely side valleys. However pleasant it may be for the passengers, the officers on the bridge and in the engine rooms have no time for dreaming. There is always wind over water. Its direction changes with distressing frequency. Where the valley curves and where side valleys open out the wind is caught and broken into eddies, which throw the ship out of her course and which must be met. The first sign of this struggle appears to the passengers when the second officer from the front car and the first engineer from the rear car walk down the long passage way, entering the cabin at opposite ends. They have entered not for sightseeing, but to take a seat. They are thoroughly worn out. A little table is put before them and breakfast is served. Their example is contagious. The passengers hasten to imitate them. Other little tables appear daintily bedecked, with white linen and silver. The steward now has his hands full. Although there is no common table, seats are close together and the noise from the engine rooms, which are each some 115 feet from the cabin is so muffled that conversation is not difficult. The officers are plied with questions. Indeed the corner of the cabin soon suggests the Captain's table of a steamer. Soon the officers rise and leave. Hardly have they gone when the Captain himself appears. He is soon called away, however, for the speed now has become quite variable, and the course no longer level. Near Coblenz all progress seems to have stopped for a few moments. The ship suddenly drops one hundred meters, but the reserve power is instantly applied and progress is resumed.

At Bonn the heights recede from the river. The valley widens out, and the ship's speed increases. The ship is now much more easily steered. No longer does it follow the many windings of the river. Straight as an arrow it plunges on at forty-two miles an hour, making up for lost time.

The landscapes are somewhat less beautiful than before. Accordingly the passengers seize the opportunity of acquainting themselves with the attractions and conveniences on board. The inevitable souvenir postcards make their appearance, and the crackling of the wireless telegraph is heard from the little laboratory at the end of the cabin. Bottles appear on the tables; some incorrigibles try to improve the situation with a game of cards.

As the destination of the ship is approached, the wash room is in demand. Duesseldorf now shows in the offing. A few minutes more and the ship will be circling over the city. This is the crowning glory of air travel, a truly fascinating sight to the tourist who sees it for the first time. All the busy streets and squares are spread out as on a map, thousands of different human activities are seen as a whole, simultaneously. No cab or street car or wagon escapes detection, no pedestrian can conceal his movements, no matter how private his errand may be.

Many a garden and park that considers itself secluded is exposed pitilessly for inspection. With a good binocular, little scenes may be witnessed, here and there, which are not strictly intended for publicity. It is perfectly obvious to a passenger in an airship why the air lines with their international clientele are forbidden to cruise over fortresses. The ship favored by a southern breeze in the last part of its trip and arriving a little ahead of time, circles very slowly. There is a fascination in such an arrival which is entirely new in the annals of travel.

The pleasures of those passengers who have indulged in a quickly developed taste for aerial detective work is cut short by the ships straightening out her course, and slowly heading for the airship harbor. Now comes a last sensation. There is a scared look on every face. All hands grip chairs and pillars when the cabin suddenly seems ready to turn a somersault. The floor is suddenly inclined at a slope never attained by a boat in the worst storm. Looking out of the window, the bow is seen headed straight for a squad of men that cluster at a spot in the open, well to leeward and away from the big shed, which here does not look quite as substantial and elegant as that at Frankfurt. Just as the airship seems about to mow the men over, water gushes from the bow. The men dodge it smartly. The propellers, which stopped soon after the downward glide began, are reversed. While the bow tips up and the ship comes to a halt the forward car slides almost into the hands of those who are ready to grip the sides of the hull. Men run for the hanging ropes. No sooner are they caught than all begin to pull and march to windward, where a double line of rails becomes visible. The first rail is passed. The steel cable on the starboard side is made fast to the nearest truck. The men on the starboard side run back and begin to pull the stern around; while those on the port side steady the ship until the hull, which at first pointed straight into the breeze, becomes parallel to the rails. Quickly other trucks are backed down into place while the hull is warped around. Then comes a deluge. Water pours from all parts of the ship; for all the ballast is emptied as soon as the vessel is securely in leash. The steel cables of the trucks are stretched as tight as iron rods, and the landing ends with the rhythmic marching of men to the shed along the rails.

Two able airmen enter the cabin to lower the gangway. The passengers look down on a repetition of what they had seen from the somewhat greater height of a steamer's deck—crowds of friends with droves of taxicabs, with hotel men and porters behind.

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INDEX.

The * Indicates that the Article is Illustrated with Engravings.

A

Accidents, prevention of.....82, *90
Acetylene fog horn.....272
Acre, how to lay off.....*464
Advertising with moving pictures...*536
Aerodynamic laboratory *445

AERONAUTICS.

—Across the Atlantic by aeroplane.*106
—Air craft in explorations.....397
—Atmospheric disturbances 42
—Blériot visits America.....415
—Brucker's expedition *243
—International Aeronautical Exhibition 355
—Mouillard monument *271
—Muscle as motive power.....506
—Eiffel aerodynamic laboratory *445
—New York aero show.....*472
—Notes.....63, 83, 151, 191, 211, 233, 283, 303, 355, 395, 415, 471, 491, 511, 544
—Wright patent in Germany...191, 221, 287
—Wright, Wilbur 471, *518

AERONAUTICS, ACCESSORIES.

—Automatic parachute *311
—"Spiron" 63

AERONAUTICS, ACCIDENTS.

—Death of Lieut. Hazlehurst 558
—Death of Parmalee.....531
—Due to "holes in the air".....42, 56
—Recent accidents 151, 191, 471
—Reichette's fatal parachute fall...*178
—Fate of Andre.....415
—Rodgers' fatal accident.....*356

AERONAUTICS, EXHIBITIONS AND CONTESTS.

—Automobile vs. aeroplane.....*209, 211
—Height record with two passengers.355
—International aviation salon.....*68
—Miss Quimby's flight across the channel *492
—Monoplane speed record.....178
—Parisian "Aviette" contest.....*542
—Pekin-Paris conditions 491, 559
—Speed records in France.....151
—Tabuteau's records.....303, 355, *397
—Vedrine's speed records...223, 191, 283
—Varriman-Seiberling Expedition ...*152

AERONAUTICS, MILITARY AND NAVAL.

—Across the Sahara.....325
—Aerial gun 350
—Aeroplane fleet for our army.....415
—Aeroplane machine gun 559
—Aeroplanes for German army.....491
—Bomb dropping in France.....491
—French dirigibles *84
—French equipment and plans.....235
—Italian-Turkish war 151, 211, 283
—Military aviation 211
—Tests of new biplane.....303
—Transporting French aeroplanes...303
—U. S. requirements, for aeroplanes and aviators 298

AERONAUTICS, PRIZES.

—Aero club offer for cup defender...415
—Gould-Scientific American Prize... 87, 349, 448, 470, 486, 517, 540, 578
—Kaiser's prize for aeroplane motors.211

AERONAUTICS.

—See also Aeroplanes.—Balloons and Airships.—Hydro-aeroplanes.

AEROPLANES.

—Aerial taxicab *49
—"American," monoplane *472
—Automobile vs. aeroplane.....*209, 211
—Boland biplane *178
—Burgess-Wright military biplane..*472
—Deperdussin monoplane *398
—Designs of racing machines.....*398
—Difficulties in steering.....129, 215
—Electric guides 263
—Galludet racing monoplane.....*472
—Automobiles for hauling.....*12
—Gyroscopic action.....239, 399, 495
—Jacobs multiplane *472
—Marcay-Mooney monoplane ..*393, *397
—Mattullath patents 365, 451, 503
—Military biplane tests.....303
—Monoplane speed records.....178
—Morane-Saulinier monoplane..*397, *398
—New Blériot monoplane.....511
—New control *178
—Paulham-Tatin aerial torpedo.....*49
—Scientific American all-steel racer.*398
—Starting and alighting.....399
—Thrust of a propeller *567
—To cross the Atlantic.....*106
—Toy flying machines.....72
—U. S. requirements.....298
—With folding wings *393, *397
—See also Aeronautics.—Hydro-aeroplanes.

African expedition, Rainey.....263

AGRICULTURE.

—Cottonseed, and its use 584
—Crop improvement 514
—Electro-culture of plants.....63, 437
—Grafting pecans on hickory.....143
—Growing Easter lilies.....319
—Increasing use of automobiles.....*137
—Many uses of electricity.....303
—Motor threshing machine.....*336
—Operation of traction engines....*126
—Remedy against cochylis.....103
—Scientific methods of soiling....*130
—Sewage plant for farm house.....*332
—Sub-soiling by explosives.....124
—Utilizing surplus potatoes.....232, 359
—See also Fertilizers.—Fruit.

"Akron"—Air ship *152
Alarm and indicator system.....221
Alkali destructive to cement.....102
Alligator farming *422
Animals, concealing-coloration *566
Animals, patents 558

ALUMINIUM.

—Diseases of 495
—Electrical uses *221
—Soldering by new alloy.....491
—Various uses 437
American Association for Advancement of Science 355
American Geographical Society, excursion 395
American Museum of Natural History *196

AMERICAN MUSEUM OF SAFETY.

—Prize for Marine life-saving.....425
—Prizes for safety devices.....82, *90
Ammunition, see Ordnance.
Amundsen, Roald *265
Andes, curious lightning in.....464
Anaesthesia, new process.....7

ANTARCTIC EXPLORATIONS.

—Capt. Scott at the South Pole.....324
—Historical sketch 265
—Mawson expedition 306
—Present expeditions 45, 191, 511
—Polar malady 559
—Shadows at the South Pole *542
—South Pole discovery.....232, 265
Anti-corrosive treatment 554
Antimonite, photo-electric 194
Antiseptic surgery *173
"Antitrades" 49

ARCHAEOLOGY.

—Discoveries at Boscoreale.....323
—New discoveries at Pompei.....*420
—Reproducing Indian inscriptions...*91
Arithmetical "nut" 174 269, 583
Armor versus gun *442
Asphaltum 556

ASTRONOMY. 4

—Fluctuations in solar radiation.....166
—Heavens in February.....*110
March *198
April *290
May *402
June *498
July *585
—Interesting asteroid Vesta.....198
—Lunar mountains 498
—Morning an evening stars, 1912...*207
—Mount Wilson solar observatory, *150, *513
—New star in Gemini.....*290
—Solar corona due to pollen.....558
—Turret telescope *218
Athletes, use of oxygen.....302
Atlantis 141
Atmosphere. See Meteorology.
Atomic theory 286
Augustine, Benjamin F.....*312
Aurora, spectrum of.....526
Austin dam, cause of break.....102
Australian trees 415
Automatic trumpeter *336

AUTOMOBILES.

—Aeroplane vs. automobile....*209, 211
—An early automobile.....542
—Armored motor vehicles *12, 50
—As a portable source of power.....448
—Burnt-gas exhaust for garage.....*111
—Curious motor sleighs *180
—Device for warming steering wheel.455
—Driving at night *18, 32
—Eight-wheeled *91
—Electric truck for switching cars..*311
—Emergency cars 578
—For fighting aerial craft.....*12
—For military purposes *12
—For road building *234
—Horses and automobiles, cost.....*561
—Light and heavy car cost.....24
—Many uses on a farm.....*133
—Motor sledding at Saranac Lake...*217
—Motor threshing machine *326
—Motor truck cost charts.....22
—New inventions needed.....*10
—N. Y. automobile show.....62
—Riding qualities 7
—Relief jack *161
—Selection of motor trucks.....*5, 16, 31
—Scientific test of electric truck...*561
—Starting cranks, obsolete.....*8
—Street cleaning in Paris.....*361
—Suspending a motor car.....100
—Teamsters for chauffeurs.....24
—The tire problem *26, 34
—Tire chain patent 96
—Varied uses of motor vehicles.....448
—Vienna auto fire engine.....*138
—Westinghouse air-spring *160

AUTOMOBILES, ACCESSSORIES.

—Acetylene generator tank.....*568
—Adjustable pedal *11
—Ajax starting crank.....*11
—Automobile starters *8
—Electrically heated gloves *568
—Fender *197
—Flywheel magneto *11
—Headlight turning device *568
—Headlights and lamps *18, 32
—Hydraulic tire-pump *423
—Kerosene vaporizer 568
—New inventions *10, *568
—Over-heat alarm *11
—Pneumatic tire armor *272
—Pump, power driven.....*11
—Shock-absorbers 7
—Test of mud-guards *235
—Tire pressure gage *11
—Wooden tire for motor trucks.....*271

AVIATORS.

—Brucker, Joseph *243
—Langley, S. P.....53
—Parmalee, C. O.....531
—Wright, Wilbur 471, *518
—U. S. military qualifications.....298
Aztec sculpture *542

B

Babbitt metal *71
Bacteria *333
Balanced rock pagoda *311
Balata, source and use 446

BALLOONS AND AIRSHIPS.

—"Akron" *152
—Brucker's air ship *243
—Highest sounding-balloon ascent.....58
—Nungesser in a Zeppelin *580
—Loss of the "Parsival VI".....511
—Photography from a balloon.....*199
—Recent French dirigibles.....*84
—Vaniman-Seiberling expedition *152
—Wire-wound dirigible *152
—See also Aeronautics.—Aeroplanes.—Hydro-aeroplanes.

Banana cloth 151
Bank notes, destroying 238, *396
Bank notes, laundering *520
Bastian, Charlton 262

BATTERIES, STORAGE.

—Bifunctional formation of plates..520
—To cleanse plates 520
Beach subway and tunnel..150, *176, 259
Bean, castor 175
Beard, 11 feet long *311
Bell-making *231, 238
Berlin Museum of German industry..175
Berliner, Emil *52, 95

BIOLOGY.

—Bastian's theory 262
—Digestion of new-born infant.....494
—Duboin' "microbolds" 530
—Life from dead matter.....262
—Life of tissue outside of its organism.....461
—Life without bacteria.....*333
—Survey of Panama Canal Zone.... 63
—See also Medicine and Surgery.
—Relation of minerals to digestion..575
Rinland .....See also Aeroplanes.
Blasting with imperialite.....*493
Blériot, Louis, in America.....415
Blind, printing system *217
Blood as a weapon of defense.....387
Blowpipe, safe that resists.....*450

BOATS.

—Curtiss flying boat *137
—Experiments with model boat.....*136
—Hints for boatman *567
—Motor ice-boating 437
—New York motor boat show.....190
—Pleasure boats debt to the racer.*14, 30
—Soap-driven model 403
—See also Hydro-aeroplanes.—Steamboats and Ships.

Book-making exposition 415
Boring bar for bushings *71
Boscoreale 323
Bottles, non-refillable 96
Brahmaputra expedition 309
Breadmaking by electricity.....395
Breathing 284
Brooklyn Bridge *189, 195
Brucker, Joseph *243
Building trades, exhibition 595

BUILDING CONSTRUCTION.

—Fire towers 150
—Fireproof buildings 132
—Fireproofing 62
—Fires from bad construction..*529, *541
—Test of concrete theater.....*51
—Use of the cement gun.....*44
—Ventilator for Hotel Raleigh.....*403
Bushings, device for pulling.....*111
Butter from trees 175
Butter, test for fats and salts.....531

C

Calendars 350, 475
California, electrical transmissions..531
Cameras. See Photography.
Canadium 98
Canal, Monkland *479
Canal, trans-Cuban 490
Canaries as mine damp testers.....*138
Cancer, campaign against.....428
Cancer, research 282, 283
Car-seating problem 170, *172
Castor bean 175
Catalytic experiments 179
Cedar for pencils 386
Cellar switch *337

CEMENT AND CONCRETE.

—Alkali, a destroying agent.....102
—Concrete furniture *52
—Concrete ties on Panama Railroad.*200
—Plastering with a hose.....*44
—Sealing rock with granite.....*44
—Test of concrete theater.....*51
—Tunnel troubles 354
—Wire to reinforce pavements.....*403
Chauffeurs of teamsters.....24

CHEMISTRY.

—Catalytic experiments 179
—Fats and salts in butter.....531
—Hydrogen-producing briquettes 463
—Influence of light upon ferments...194
—Sifter for laboratory.....*179
—National manufacturers' laboratory. 42
—New element, "Niton" 358
—Of what is a man?.....311
—Peroxide-hydrogen, made by sunlight 200
—Photo-electric automobile 194
—Simple fire extinguisher 179
—Spectometer, home made *383
—Sulphur in pyrites and pyrrhotite..179
—Tests of welds 171
—Welsbach, Carl Auer *327
Chestnut tree blight *241
Chicle from the zapote tree.....428
China, electro-plated *220, 263
Chuck, emergency two-jaw *111
Chucks, magnetic 471
Circular track of lost persons.....302
Clamp for screening doors.....*423
Clay-eaters 506

CLOCKS.

—Electrically driven 103, *219
—Notre Dame Cathedral clock.....*403
—Short alarms *92
Cloth. See Textiles.
Coal dealer's scales *91
Coal tar 534
Coast Defense. See Naval Affairs. Ordnance.
Cochylis 103
Coffee-pot, overflowing *479
Cohendy, Michael *333
Coin change machine *200
Coins, bought by mint.....286
Coleman du Pont highway.....*244
Columbia University *326
Commerce, Chambers of 299
Commercial high schools 66
Concrete. See Cement and Concrete.

CONGRESSES.

—American Road Congress.....574
—Geological Society of America..... 46
—International Congress of Chambers of Commerce 299
—International Electrotechnical Commission 515
—International Navigation Congress, 204, 437
Conservation of human life.....82, *90
Conveyors for kegs.....*138
Cottonseed and its uses 584
Crocker, Francis Bacon *43
Crocker Land 122
Crop improvement 514
Cuba, canal across 490
Cylinder bushing, boring bar.....*71

D

Dairy problems in the tropics.....558
Dam, Austin 102
Dam, Klingenberg *492
Dates, artificially ripened *512
Davis, Cleland 350
Deaf mutes *72
Delaware highway *244
Dental inlay patent 180, 201
De Quervain's expedition 492
Diamonds from illuminating gas.....*478
Dictographs *284
Diesel, Rudolf *257
Diesel engines .170, 191, 233, *357, *500
Digestion, effect of minerals.....575
Digestion of infant 494
Disk, centering *71
Door frame, method of clamping....*111
Drafting pencil, three lined.....*567
Dredge, suction *489, 494
Drills for screws and taps.....*111
Drydock—Brooklyn yards 151, *473
Dust, counting grains.....*497

E

Earth-eaters 506
Ear protectors *219
Earthquakes. See Seismology.
East River, opening.....190, *379, 437
Easter lilies 319
Echoes, vagaries of 69
Edison, Thomas A.....*52

EDUCATION.

—Electric treatment for backward children *334
—German industrial 66, *193
—Gift to Mass. Inst. of Technology.*280
—Household arts at Columbia University *325
—Montessori methods 470, *564
—Need of technical schools.....202, 314
—Of railroad men.....*158
—Rousseau institute 355
—Salaries of instructors.....395
—See also Technical Training.
Egg, double *199
Egyptian incubators 437
Ehrlich Wassermann, cancer researches 282, 283
Eiffel, Gustave *445
Eiffel time signals 437
Eiffel Tower.....49

ELECTRIC APPARATUS AND APPLIANCES.

—Automobile starters *8
—Bell ringing transformer.....*383
—Drive for looms 437
—Electric clocks 103, *219
—Electric furnace *291
—Electric steel furnace.....437
—Fire-damp alarm *161
—Fireless cooker *336
—For removing oil from water.....*450
—Heater for water tank.....437
—Heating in Norway 171, 396
—Live wire detector *199
—Machines for bread making.....395
—Motor scrubbing machine.....*161

ELECTRIC LIGHTING.

—Automatic cellar switch.....*337
—On railroad trains 151
—Metallic filament for lamps.....*327
—Tungsten lamp patents *364

ELECTRIC RAILROADS.

—Car-seating problem 170, *172
—Improved tram-car designs, 47, *336, 415, 491
—Grinding rails at welded joints....*479
—Reliability of single-phase system.375
—Trailers in Pittsburgh *172
—See also Railroads.—Subways.

ELECTRICITY.

—Applications in coast defense.....395
—Automatic control of rotary converter 395
—Cost of different installations....375
—Damage to sub-surface metallic structures 511
—Electrified children *334
—Electro-culture of plants.....63, 437
—Handy series current tap *423
—Heating an office building.....471
—Hydro-electric plant 171
—International Electrotechnical Commission 515
—In the U. S. Printing Office.....531
—Maintaining constant level 170
—Many uses on the farm.....303
—Mercury vapor rectifier 278
—Molten glass as a conductor.....512
—Notes.....47, 63, 83, 103, 125, 171 211, 233, 263, 283, 303, 325, 375, 471, 511, 531
—140,000-volt transformers 211
—Plowed field as line conductor.....511
—Simple resister *111
—Storage battery plates.....529
—Thawing water pipes 233, *290
—Thermomagnetic motor *519
—To rid piling of the tiredo pest....*403
—Transmissions in California.....531
—Use of aluminum.....221
Electron theory 286

ELECTROPLATING.

—Metals, china and wood 220, 263
—Nickel 125
Elephants, cleansed of paint.....*311

ENGINEERING.

—Cement troubles in tunnels.....354
—Controlling water waste.....302, *304
—Dredging Mississippi river....*489, 494
—Engineers in manufacturing.....314
—Galveston causeway *581
—Jungfrau tunnel *285
—Montmartre hill tunnel *86
—Notes.....47, 103, 125, 151, 171, 191, 211, 233, 263, 325, 355, 375, 495
—Romance of 124
—Shall my boy become an engineer 202, 314, 408, 504
—Water sterilizing plant *268
—Weston, Edward *312
Elevators, safety device 293
Elevators, subway *89

ENGINES.

—New rotary engine *312
—Superheated steam engines, 102, *213, 595
—Traction engine for farm.....*126
Engravings, reproducing 519
Equitable Building fire 62
Ericsson, John *153
Eskimos as inventors 221
Eskimos of Victoria Land.....43
Esperanto 96
Engines 324
Evolution, Johannsen's theories of..*310
Exercising in bed *512
Exhaust for a garage.....*111
Explorations in air craft.....397
Explosives for sub-soiling 124
Explosive, safety *493

F

"Fata Morgana" 335
Fatigue, eliminating mental.....397
Federal control of water power.....299
Ferments, effected by light.....194

FERTILIZERS.

—By-product of packing houses....*538
—Mixing materials *130
—Peruvian guano 530

FIRES AND FIRE SERVICE.

Automobile fire engine.....96
—Co-operative fire protection 572
—Fire exposition 502
—Fire alarm and indicator.....221
—Fire towers 150
—Fire waste and prevention.....132
—Fire waste of the U. S.....*529, *541
—Home-made extinguisher *179, 307
—Improving fire departments.....132
—Lessons of Equitable fire 62
—Matches and fire 486
—Preventing forest fires.....*49
—Storing inflammable liquids.....*416
—Vienna auto fire engine.....*138
Fire damp *138
Fireless cooker, electric *236
Fireproof Construction. See Building Construction.

FISH AND FISHERIES.

—Fish culture in Germany.....*533
—Memory of fish.....471
—Phosphorescent bait 395
—Phosphorescent fish 512
—Sleeping fish 137
—Temperature and color of fish.....138
Florida, U. S. Battleship *308
Flowers, metal *219
Fog horn, acetylene 272

FORESTRY.

—Bulletin on oak woods.....303
—Cabole tree 444
—Canadian conservation 191
—Commercial woods 226
—Chestnut tree blight 105, *241
—Forest bill 302, 495
—Introducion of Nammu tree 474
—North American gum woods.....529
—Panama hat palm 494
—Patent for healing tree wounds..521
—Preventing fires *48
—Tall trees in Australia.....415
—Time to cut timber 185
—Trees that yield butter.....175
—Utilizing waste timber *537
—Willard tree freak *271
—Zapote tree a source of chicle.....428
Formic acid 574
"Forty-pound horse collar" 227
Fountain pen with windows 293
Fourth dimension 214
Frost flowers *64
"Froude," model boat *136

FRUIT.

—Fruit trees by roadsides 82
—Orchard heaters *135
—Peach tree freak 199
—Ripening dates artificially.....*512

FUEL.

—Coal dealer's scales.....*91
—From Nile river sudd..... 84
—Problems in saving *539
Fume-condensing 53
Furnace, electric *291
Furniture, concrete *52
Furniture "revivers" 154

G

Gages, surface *71
Galveston (Tex.) causeway.....*581
Garage, exhaust *111

GAS.

—Bottled for home use 415, 471
—Diamonds from illuminating gas...*478
—Devices for cooking *223
—Gretzine gas burners 350
—Incandescent light mantle *227
—Manipulation of mantles.....255
—Precious stones from waste 562
—Utilization of waste gas 534
Gas Engines. See Internal Combustion Engines.
Gasoline can, safety device.....*161

GEOLOGY.

—Blowing and sucking wells.....242
—Cause of glacial period.....65
—Geological Society of America..... 46

GERMANY.

—Battle cruiser "Moltke".....*590, 578
—Commercial high schools.....66
—Industrial conditions.66, 134, *193, 534
—Labor question 134
—Museum of Industry 175
—Number of physicians 98
—Waste utilization 562
Glacial period 65
Glass, electro-plated *220, 263
Glass labels *92
Glue, tests for quality 556
Goitre, experiments 260

GOULD-SCIENTIFIC AMERICAN PRIZE.

—Arrangements for contest.....540, 578
—Entries for 518, 540
—Rules governing..87, 349, 448, 470, 486
Gravity, force of, measured *104
Great Eastern and Titanic.....414, *417
Greenland expeditions.....103, 375, 492
Grills, gas heated.....*323
Grinding wheels, making.....270
Grinding wheel tests.....*271
Guana, Peruvian 530
Guns for placing cement.....*44
Gum woods 527
Guns and Gun-powder. See Ordnance.
Guyer-Zeller, Adolf *285
Gymnastics, training for nerves.....479
Gyro-compass 382, *588

H

Hail storms, protection against.....584
Hawke-Olympic collision....170, 215, 239
Heating devices, Norway.....171, 396
Heavens. See Astronomy.
Heroism of medical men.....164
Herschel, Sir William 572
"Holzapfel I" *50
Home laboratory, *92, *179, *291, *383, *519
Horse collar, metal 227

HOUSEHOLD ARTS.

—At Columbia University.....*326
—Electric dreless cooker *336
—Housekeeping experiment station.*330
—Kitchen conveniences *542
—Motion study in household.....328
Huneke-Martini apparatus *416
Hydraulic cartridge *564
Hydraulic shield *176

HYDRO-AEROPLANES.

—Contest at Monaco.....151
—Curtiss flying boat.....*137
—Meeting at Monaco.....*356
—New York motor boat show.....190
—Queen aero boat.....*472
—Robinson's accident *219
Hydro-electric plants. See Water Power.
Hydrogenite 463

I

Icebergs *377
Ice boats, motor *217
Illusion, light and shade.....*519
Imagination in science.....6
"Imperialite" *493
"Imperator," rudder post.....*479
Incubators, Egyptian 437
Indian heads cast from life.....*196
Indian inscriptions *91
Indian sea, light phenomena.....*51
Indicator and alarm system.....221
Industrial conditions, Germany, 63, 134, *193, 534
Infant, digestive powers.....494
Insects. See Natural History.
Inscriptions, Indian *91
Insurance, industrial 134, 351

INTERNAL COMBUSTION ENGINES.

—Cooling device 95
—Diesel engine..170, 191, 233, *357, *500
—For motor-boats *14, 30
—Internal combustion turbine.....*543
—Jenkins starting device.....501
—Marine producer-gas *56
—Motor ship "Selandia".....*264
—Removing from automobiles.....*17

INVENTIONS.

—Automobile accessories *10, 28
—Brief notes.....63, 95, 180, 201, 249 293, 340, 365, 385, 480, 528, 543 568, 569
—Use of aluminium 221
—Given to the public 305
—Little things that make big inventions 452
—Military inventions 452
—Need of excavating apparatus..... 53
—Red Cross Society prizes.....59
—$7,500 for a non-slipping rubber....273
—Simplicity a merit.....160
—Would-be and the actual inventor.455
—See also Patents.

INVENTORS.

—Croker, Francis Bacon.....*43
—Esquimau as an inventor.....221
—Inventors' Guild 160, 210
—Jenkins, C. F.....*292
—Jorgensen, J. C.....72
—Notes...52, 72, 112, 160, 180, 200, 220 272, 292, 312, 338, 364, 384, 521, 544
—Prizes for 392
—Westinghouse, George 577, 582
—Women as inventors.....*338
Ireland—ancient oratory *138
Iron, non-corrodible coatings...325, 554
Iron waste, briquettes *477
Irrigation in Luzon.....*108

J

Jack, automobile *161
Jenkins, C. Francis.....*292

Johannsen, Wilhelm *310
Jorgensen, J. C. *72
Jungfrau tunnel 285

K

Kegs, conveyors *138
Keys, suggestions for *543
Key West Railroad 102
Kinemacolor processes *70, 287
Kitchen work lightened *542
Klingenberg dam *492
Koln nut 137
Kubus of Sumatra 125

L

Labels, glass *92
Labor question 434
Laboratory for manufactures 47
Laboratory labels *92
Laboratory lifter *179
Lackawanna Railroad 6
Lactic acid 574
Langley, Samuel Pierpont 53
Laryngoscope *72
Lead burning 533
Lemon, "chicken-foot" *51
Lead sulphate, to remove from plates..520
Lemons, "chicken-foot" *51
Lenses with plane surfaces 283
Life, artificial 530
Lifeboats. See Steamboats and Ships.
Life from dead matter 262
Life of tissue outside of its organism..461
Life rings *219
Life saving device (at sea) 425
Life without bacteria *332
Lifter for laboratory *179
Light and shade illusion *519
Light, influence on ferments 195
Light phenomena of Indian Sea *51
Lighthouse, oldest 155
Lightning and telephone wires 47
Lightning arrester, largest *479
Lightning in the Andes 464
Lightning, new ideas *584, *586
Lilies, Easter 319
Linden Museum 266
Liquids, inflammable, storing *416
Liquids in tanks, weighing *478
Lister, Joseph *173
Live wire detector *199
Locomobile *213
Locomotives. See Railroads.
Lohmann's non-corrodible coating 554
Longevity and sour milk 65
Los Angeles aqueduct *171, *469, 476
Lost persons 302
"Lusitania's" bridge *271
Luzon, irrigation *108

M

Magnetic chucks 471
Magnetos, flywheel *11
"MAINE."
—Burial at sea *281, *288
—Disposal of memorials 103
—Explosion explained *85
"Making the machine sew" 256
Malladra, Alessandro *532
Man, chemical view of 311
Manholes, sinkable *424
Map for the blind *217
Marathon races 302
Marine exploration *169, 174
Martians 262
Massachusetts Institute of Technology *136, *263, 289
Matches and fires 486
Mattuliath patents 365, 451, 563
"Mauretania" *417
Meat industry, by-products *538
MEDICINE AND SURGERY.
—Amesthesia, new process 7
—Apparatus for exercising in bed ..*512
—Apparatus for thoracic operations..112
—Artificial mountain air *197
—Artificial snow in skin treatment..387
—Campaign against cancer 428
—Church, eugenics and immigration..334
—Curative powers of "Niton" 358
—Digestion of new-born infant 494
—Effect of exercise on the heart *512
—Eliminating mental fatigue 297
—Father of antiseptic surgery *173
—Goitre 200
—Grafting a cornea on a blind eye..355
—Heroism of medical men 164
—Immunity against poisons 478
—Japanese treatment of syncope 196
—Lister, Joseph Baron *173
—Physicians in Germany 98
—Polar malady 559
—Prizes for inventions 59
—Radium spa 256
—Reduction of arterial pressure *334
—Wassermann-Ehrlich researches 282
—Wourahli poison preparation 258
—See also Biology.
Melville, George W. 282
Mental fatigue overcome 397
MERCHANT MARINE.
—Large exports should bring 67
—National issue 219, 359, 379
—Plan to revive 129
Mercury vapor rectifier 278
Metal flowers *219
METALLURGY.
—Canadium 98
—Lohmann's process for non-corrosion..554
—Non-corrodible metal coatings 325
—Use of moving pictures in tests 394
—Vanadium steel 118
—See also Aluminium.—Iron.—Steel.
Metals, testing for hardness *71
Metal waste made into briquettes ..*477
METEOROLOGY.
—Abnormal summer of 1911 306
—At St. Louis University 437
—Curious light phenomena *51
—Drought in tropical America 375
—Dust storms *497
—Great storm of 1703 155
—Hailstorms, protection against *584
—Highest balloon ascent 58
—"Holes in the air" 42, 56
—Lightning *584, 586
—Lightning in the Andes 464
—Mares' nests in phenomena 530
—Mirages of Calabrian coast *335
—Night storm signals *300
—Phenomena in Chesapeake Bay 399
—Plans for Greenland expedition 492
—Service of South Africa 471
—Spectrum of the aurora 526
—Rainbows 305
—Rotch, Abbott Lawrence 354, *376
—Spectrum of the aurora 526
—Trade-winds 96
—Thunder, distance heard 77
—Wireless weather reports 49
—World tour of inspection 105
Mexican serpent head *542
Microbiotds 530
Microscope stands *291
Milan's water supply 137
MILITARY ART AND SCIENCE.
—Coast defnse of U. S. 436, *438, 440
—Military inventions 452
—Subsidizing motor vehicles *12
—See also Aeronautics, Military and Naval.—Ordnance.
Milk, modified 171
Milking machine *112
Milling machine from planer *270
Mimeograph, rotary, 262, 273, 287, 307, 329, 339, 359
MINES AND MINING.
—Canaries for detecting fire-damp ..*138
—Fire-damp alarm *161
—Freezing water in shaft 125
—Hydraulic cartridge *304
Mines, submarine *444
Mirages of Calabrian coast *335
Mississippi River, dikes 475
Mississippi River, dredging *489, 494
Mississippi River floods 255, 495
Mississippi valley, drainage 495
Money, paper, destroying 238, *396
Money, paper, laundering *520
Monitor of 1862 ....*153
Monkland canal *479
Monoplanes. See Aeroplanes.
Montessori, Maria 479, *564
Mop wringer *384
Motion study in household 328
MOTOR CYCLES.
—Novel automobile bicycle *51
—Improvements of 1912 ....*19
Motor, thermo-magnetic *519
Mouillard, Louis Pierre *271
Mt. Wilson, "Old Man" of *403
Mount Wilson Observatory *156, *513
Mountain air, artificial *197
MOVING PICTURES.
—At home *273
—Colors reproduced *70
—For school use 471
—Industrial uses *536
—Use of glass plates *477
—Use in scientific study 394
Mushrooms, poisonous 159

N

Nammu tree 474
Narwhal tusks *51
NATURAL HISTORY.
—Alligator farming *422
—Blood, weapon in insects 387
—Cochylis 103
—Concealing-coloration in animals ..*566
—Elephant seals *138
—Fish, memory of 471
—Light of the piddock 102
—Luminosity of deep-sea creatures..512
—Marine explorations *169, 174
—Narwhal tusks *51
—Rainey African expedition 263
—Titanothere *301, 315
NAVAL AFFAIRS.
—Battle-cruisers for U. S. Navy 578
—Battle-cruisers for our navy 6
—Brooklyn navy yard drydock..151, *473
—Chain of wireless stations *390
—Coast defenses of the U. S. 436, *438
—Death of Admiral Melville 282
—East River channel 190, *379, 437
—Electricity in coast defenses 395
—House appropriation bill 510
—Increase in world's fleets 296
—Increase the U. S. coast artillery..436
—Necessity of maintaining standard..124
—Retrenchent a peril to U. S. 436
—Submarine mines in coast defense..*444
—See also Aeronautics, Military and Naval.—Ordnance.
Navigation and Eiffel time signals ..437
Navigation, International Congress, 204, 437
Navigation in northern waters 558
Nerve training by gymnastics 479
"Nevada," U. S. battleship *85, *212
NEW YORK (CITY).
—Aero show *472
—Automobile show 62
—Beach subway (1866) 150, *176, 359
—City Hall Park 82, *189, 195, 490
—Motor boat show 190
—Opening East River 190, *379, 437
—Opening of naval drydock *473
New York (State) water power 151
Nile River sudd 84
"Niton" 358
Non-corrodible coatings 325, 554
Norton Company *90
Nuts, kola 137
Nuts, pecans 143

O

Ocean surf shakes the earth 558
Oak woods, bulletin 320
Observatories. See Astronomy.
Occupations, unusual 462
Oil Engines. See Internal Combustion Engines.
Oil from water, removing 450
Oil heaters for orchards *135
Oil paintings, renovating 151
"Oklahoma," U. S. battleship..*85, *212
"Old Man" of Mount Wilson *403
Oleomargarine, manufacture *192
Optical phenomena of rainbows *305
Optics, atmospheric 530
Orange, gourd-shape *51
Oratory of Gallerus *138
Orchard heaters *135
ORDNANCE.
—Aerial gun 350
—Aeroplane machine gun 559
—Coast defense batteries 438
—Concealed battery of coast defense..*441
—Double report in gun fire 67, 187
—Ear protectors for gunners *219
—Guns of the coast defense *440
—Guns versus armor *442
—"Imperolite," safety explosive..*493
—Range-finding tower *438
—Self-scoring target *159
—Smokeless powder 358
—Three-gun turrets *85
—Vickers automatic gun *169
Oxygen for athletes 302
Ozone sterilization 490

P

Pacinotti, Y. 374
Packing house by-products *538
Pagoda on balanced rock *311
Paintings at Pompeii *420
Palm, Panama hat 494
PANAMA CANAL.
—Biological survey of zone 62
—"Human interest" 210
—Question of tolls 82, 150
—Personal impressions 353, *363, *516
—Effect on steamship routes 104, 151
—Senator Bristow's bill 150
—Slides in the Culebra cut 233, *516
Panama hat palm 494
Panama Railroad, concrete ties *200
Paper money, destroying 238, *396
Parachutes. See Aeronautics, Accessories.
Paris aero show *68
Paris—electricity from Rhone 47
Paris—subway *86, 283
Parmalee, C. O. 531
Parsons, Hinsdill 425
Parsons, Sir Charles 124
PATENT OFFICE.
—A separate department 425
—Court of patent appeals 201
—Improved classification 481
—In the good old days 220
—Report of commissioner 200
PATENTS.
—Addition is not invention 425
—Bankrupt owners of applications..481
—Berliner talking machine *52, 95
—Bills now before Congress 394
—British patents and application 521
—Commission recommended 470
—Compulsory license question 414
—Court discusses aggregation 481
—Cuttrell fume-condensing 53
—Danger of delays 250
—Decision on process patents 251
—Dedicated to the public 112
—Dental inlay patent 180, 201
—Disclosure of trade secrets 73
—Efforts to reform patent system..210
—Expiring this year 480
—For plants and animals 558
—Foreign trade-mark registration 251
—Guarantee to secure patents 73
—Hearing on the Patent Bill 405
—Importance of prompt filing 365
—Legal notes 96
180, 201, 250, 274, 341, 481, 521, 544
—Maintaining prices on patented articles 501
—Marking devices "patented" 251
—Mattuliath aeroplane patents ....
365, 451, 563
—Oldfield patent bill 535
—Patent assignments 96
—Plea for new patent laws 160
—President recommends a commission 470
—Price restrictions 341
—Proposed legislation 385
—Reduction to practice 521
—Rotary gear pump *384
—Rotary mimeograph case, 262, 273, 287, 307, 329, 339, 359
—Secrecy of inventions 340
—Selden case 307, 569
—Sherman anti-trust law 436
—Similarity of mark, tending to deceive 251
—Tire chain 96
—Trade mark development 364
—Tungsten lamps 364
—Use of patented invention 162
—U. S. must pay for infringement..481
—Wright and Mattuliath 563
—Wright patent in Germany, 191, 221, 287
—See also Inventions.—Patent Office.
Peach tree freak 199
Pecans grafted on hickory 143
Pencil, three-line drafting *567
Pencil cedar, substitute 386
Pennsylvania Railroad 325
Phenomenon in Chesapeake Bay 399
Peroxide-hydrogen made by sun rays..260
Petroleum in Turkestan 191
"Petropaviovsk" 278
PHONOGRAPHS.
—Automatic record stop 404
—Dictating machine *284
—Edison recording stylus 481
—New optical phonograph *382, 535
Photo-electric autimonite 394
"Photogrammetric gun" *123
PHOTOGRAPHY.
—Bettini apparatus for moving pictures *477
—Color photography 63, 142, 287
—Distortions, real and faked *309
—From a balloon *123, *199
—125-foot tripod *199
—Sculpturing with the camera *496
—Transmission over telephone wires..*493
Physicians in Germany 98
PHYSICS.
—New notions of matter 286
—Passing of Pacinnotti 374
—Principle of Relativity 525
—Road building experiment station 47
Piano-player with violin *216
Piddock, light of 102
Pitometer *504
Plants, patents for 558
Planer converted into milling machine *270
Pneumatic automobile starter *8
Poison in mushrooms 159
Poisons, immunity against 478
Poison, Wourahli 258
Police telephone 250
Pollen causes solar corona 558
Pompeii, paintings discovered *420
Pontoon method of life saving *413, *418, 585
Port Sudan 47, 324
Postage stamps, abolishment 67
Postage stamps, printing 238
Postal service on subways 262
Potatoes, drying 232, 559
Prick punch, double-pointed *425
Principle of relativity 525
Printing, electric appliances 531
Printing for the blind *217
Producer-gas engine *50
Propeller, measuring thrust *567
Pump, automobile *11
Pump, rotary gear *384
Pump, tire *423
Punch, prick, double-pointed *425
Pure Food and Drugs Act 282
Pyrites 179
Pyrrhotite 179

Q

Quimby, Miss Harriet *492

R

Radiographic study of the heart *512
RADIUM.
—Austrian monopoly 429
—"Radium Emanatorium" 171
—Spa in Bohemia 256
Rail-grinding machine *479
RAILROADS.
—Advantages of steel cars *105
—African railway projects 47
—American railroads in Uruguay 376
—Battery locomotives 103
—Concrete ties on Panama R. R. *200
—Electric switching truck *311
—Electrifying at small expense 471
—Fast track laying 211, 329, 419
—Floating trains *292
—Florida East Coast 102
—Gas-electric car 415
—Government road in Alaska 327
—Jungfrau railway tunnel 235, *287
—Locomotive curiosities 167
—Nood-Sud Railway *86
—Pennsylvania Railroad 325
—Peril of the steel rail 190
—Prevention of accidents 82
—Railroad economy 211
—Reduction of grades 6
—South American Transcontinental R. R. *88
—Steel cars safer *105
—Superheated steam locomotives 595
—Telephones for announcing trains 325
—Train dispatching by telephone 395
—Train-lighting instruction car 151
—Training railroad men *158
—Trans-Andine railways 154
—Vacuum cleaner for cars 161
Rainbows *305
Rainey African expedition 263
Range finding tower *438
Ranges, gas-heated *323
Rectifier, mercury vapor 278
Red Cross Society prizes 59
Relativity, principle 525
Resister, electric *111
Rhinoceros, ancestor of *301, 315
Rhone river, power from 47
Rice terraces *108
ROADS AND ROADMAKING.
—"A stitch in time—" 470
—American Road Congress 574
—Bills before legislatures 240
—Coleman du Pont highway *244
—Experiment station 47
—Federal assistance *236
—How to build good roads *236
—Maintenance necessary 414
—Object lessons 232
—Reinforced concrete pavements *403
—Transcontinental highway 535
—Use of auto in roadmaking *234
Rodgers, Calbraith P. *356
Rotary gear pump *384
Rotch, Abbott Lawrence *354, 376
Rome, a seaport 263
Rousseau Institute 355
Rubber substitutes for tires *26
Rumsey's steamboat 73
Ruins, Irish *138
Russia's seismological service 177

S

Sahara Railway 375
Sailors' Unions 447
Safe, that resists the blowpipe *450
Safety device for gasoline can *161
Safety device for grinding wheel *90
Safety devices, medal for 82, *90
SANITARY ENGINEERING.
—Power from sewage 562
—Private sewage disposal plant *332
—Sewer cleaning device *543
—Sinkable manholes for pipe sewers..*424
—Smoke and soot in the air 46
—Street cleaning automobiles *479
—Tricycle street sweeper *479
—Saranac Lake, sledding *217
—See also Water Supply.
Scales, coal *91
SCIENCE.
—American Association for the Advancement 63
—Heroisms of medical men 164
—Human side of great scientists 530
—Life without bacteria *333
—Marine exploration *169, 174
—Moving pictures in scientific study..394
—Nationalism and Internationalism..324
—Notes, 47, 63, 83, 103, 125, 151, 171, 191, 263, 283, 303, 325, 355, 375 471, 511, 531.
—Pioneer work 50
—Publication of Herschel papers 572
—Rotch, Abbott Lawrence 354
—Science in a passion 282
—Scientific terms 150
—Value of imagination 6
—Welsbach, Carl Auer *367
SCIENTIFIC AMERICAN.
—All steel racing monoplane *398
—Appreciation of the discussion of "Titanic" disaster 485
—Gould Scientific American prize ....
—Rules governing 87, 349, 486
—Entries 518, 540
—Arrangements for contest 540, 578
—Medal for the conservation of human life and limb 82, *90
SCIENTIFIC MANAGEMENT.
—Domestic engineering *330
—In the improvement of crops 514
—Motion study in household 328
—Railroad economy 211
Screening doors, clamp *423
Screw, to extract *567
Screws, device for holding *71
Screws, size drills *111
Scrubbing machine, electric *161
Sculpturing with the camera *496
Sea exploration *169, 174
Seals, elephant *138
Searchlight, movable *438
Searchlights on ocean liners 399, 419
Sea-wall repaired with cement *45
Selberling-Vaniman Trans-Atlantic Expedition *152
SEISMOLOGY.
—At St. Louis University 437
—Earthquakes from wind 558
—In Russia 177
—Malladra's descent into Vesuvius ..*532
—Predicting earthquakes 511
"Selandia" *264
Selden patent case 307, 569
Seltzer water, dangers 286
Sensation, mechanically illustrated 365
Senses, lying *496
Serpent head excavated in Mexico *542
Sewage disposal for country home ..*332
Sewing machine, invention 256
Shade and light illusion *519
Shall my boy become an engineer 202, 314, 408, 504
"Sinking of the Petropaviovsk" 278
Skin treatment 387
SLEDS AND SLEIGHS.
—Motor sleds at Saranac *217
—Motor sleighs in Europe *180
—Motor bob-sled *271
Smoke and soot in the air 46
Smoke prevention 285, *539
Smudge pots *135
Snelling gas 415, 471
Snow, artificial 387
Snow crystals *64
Snow garlands *61
Snow melters 191
Soda, manufacture 562
Solar radiation 166
Sour milk and longevity 65
South American railroad 113
Spading machine 283
Spangler, Henry W. 283
Spectrometer, home-made *383
Standpipe failure 171
STEAMBOATS AND SHIPS.
—Activity in building 235
—Automatic life rings *219
—Bridge of "Lusitania" *271
—Electrical sea pilot 521
—Experiments in ship construction..*196
—Growth in size of turbine 171
—International Congress of Navigation 204
—Launching life-rafts *501
—Life boats, improved davits *480
—Marine Diesel engine, two-cycle *500
—Means for launching life-boats *404
—Motor liner, "Selandia" *264, 355
—Nesting lifeboats 419, 437
—Northern steamship routes 558
—"Olympic"-"Hawke" 170, 171, 215, 239
—Perils of the deck-load *308
—Pontoon plan *413, *418, 585
—Prize for life saving device 425
—Rudder post of "Imperator" *479
—Rumsey's steamboat 73
—Safety at sea 436
—Searchlights on ocean liners 399, 419
—Sir William White, naval architect..*499
—The "unsinkable ship" *417
—See also War ships.
STEEL.
—Electric furnace 437
—Endless belting 265
—Industry and smoke 285
—Lead-coated 499
—Non-corrodible metal coating 325, 554
—Rails 190
—Railway cars *105
—To restore when burnt 71
—Vanadium 118
—Welding test 171
Steinmetz, Charles P. 370
Sterilization, ozone 490
Storms. See Meteorology.
Street cleaning automobiles *361
Street sweeper, tricycle *479
Storage batteries. See Batteries, Storage.
Submarine mines in coast defense..*444
Submarine power cable 171
Submarine. See Warships.
SUBWAYS.
—Car-seating problem 47, 170, *172
—First built by A. E. Beach, 150, *176, 359
—For postal service 262
—Paris *86, 283
—Ozonized air for 47, 190
Suction dredge *489, 494
Sudan, Port 324
Sudd, Nile 84
Sugar bowl, mechanical *272
Sugar, uses of 486
Surface gage *71
Surgery. See Medicine and Surgery.
Surveying a square acre *464
Surveying in a balloon *123
Syncope 196

T

Talking machine, Berliner's *52, 95
Tank, to prevent bursting *71
Taps, size drills *111
Target, self-scoring *159
Taxicab, aerial *49
Technical Museum of Vienna 286
TECHNICAL TRAINING.
—Donation to Mass. Inst. of Technology *289
—For railroad men *158
—German systems 66, *193
—Household arts at Columbia University *325
—Need of engineers 314
—Present day need 202, 314
—See also Education.
TELEPHONY.
—Dictographs *284
—Loud speaking annunciator 325
—Police telephones 250
—Service in New York and Paris 263
—Telephones for taxicabs 171
—Train dispatching 395
—Transmission photographs *493
—Vestpocket transmitter *112
Telescope, at small cost *519
Telescope, turret *218
Telescopes, Mount Wilson observatory, *156, *513
Ten stories 205, 227, 256, 278, 370
Teredo destroyed by electricity *403
TEXTILES.
—Banana cloth 151
—Cloth from wood 562
—Electric drive for loom 437
—Treatment of woolen fabrics 125
Theater, test of strength *51
Thermo-magnetic motor and generator *519
Thunder-distance heard 77
Timber, time to cut 185
Timber, waste *537
Time signals by wireless 65
Timer, audible *92
Tire pump, hydraulic *423
Tires, substitutes for rubber *26
Tire, wooden *271
"TITANIC."
—Answers to correspondents 436
—Appreciation of Scientific American discussion 485
—Comments by correspondents..399, 419
—Compared with Great Eastern 414, *417
—Description of wreck *380
—Lessons of the disaster 374
—Light out of a dark tragedy 374
—Original plan for life boats *404
—Protection against flooding *417
—Senate committee's report 510
—Senate investigation 394
—Sunk to the bottom 374
—Tribute to the engineers 394
Tools, use and misuse *270, *337
Torpedo monoplane *49
Toys, mechanical *400
Track laying, rapid 211, 329, 419
"Tractioneer" *126
Trade marks, assignment of 96
Trade mark developments 569
Trade-winds 49
Train built of lemons and oranges ..*403
Transformer, bell-ringing *383
Trees. See Forestry.
Trucks, motor. See Automobiles.
Trumpeter, automatic *336
Tsangpo-Brahmaputra question 309
Tubing, sawed at angle *367
Tungsten lamp *364
TUNNELS.
—Cement disintegration 354
—Jungfrau *285
—Under Montmartre Hill *82, *86
TURBINES.
—Growth in size 171
—Herring-bone spiral *364
—Increased efficiency 154
—Internal combustion turbine *543
—Parson's turbine 95, 124
—Review of development 124
Typewriter, syllable *424

U

U. S. Army. See Aeronautics, Military and Naval.—Military Art and Science.
U. S. Bureau of Chemistry 282
U. S. Bureau of Printing and Engraving 238
U. S. Navy. See Aeronautics, Military and Naval.—Naval Affairs.
U. S. Printing Office 531

V

Vacuum aparatus *92
Vacuum bottle 249
Vacuum cleaner for railroads *161
Valveless engine *72
Vanadium steel 118
Vaniman-Selberling Trans-Atlantic Expedition *152
Varnish for furniture 154
Varnish, removing 151
Ventilator, largest *403
Vesuvius, exploration *532
Vicker's automatic gun *169
Vienna Technical Museum 287
Violin player *216
Vises for small screws *71

W

Wassermann-Ehrlich researches, 282, 283
WARSHIPS.
—Annual increase necessary 124
—Battle-cruisers for U. S. Navy 6, 578
—Development of the turret-ships ..*153
—Ear-protectors for gunners *219
—Engines for submarines *500
—Increase in world's fleets 296
—Launching the "Queen Mary" 231
—"Maine" *85, 281, 288
—"Moltke," German battle cruiser, *500, 578
—"Monitor" *153
—"Nevada" *212
—"Oklahoma" *212
—Olympic-Hawke 170, 171, 215, 239
—Sinking of the "Petropavlovsk" 278
—Three-gun turrets *85
—Trial trip of "Florida" *308
—"Warrington," accident 61, *95
—White, William, naval architect..*499
—See also Naval Affairs.—Ordnance.
WASTE UTILIZATION.
—In Germany 534, 562
—In gas manufacture 534
—Of dead timber *537
—Packing house by-products *538
—Smoke consumption *539
Water from oil, removing 450
WATER POWER.
—Federal control 232
—In New York State 151
—Largest overshot waterwheel *336
—Million H. P. hydro-electric plant..171
—Principles of development 239
Water, seltzer 286
WATER SUPPLY.
—Controlling waste of *302, *304
—Device for lessening waste *304
—Hydro-electric power in U. S. 491
—Los Angeles aqueduct *469, 476
—Standpipe failure 171
—St. Petersburg's sterilizing plant..*268
—Thawing water main *269
—See also Sanitary Engineering.
Water pipes, thawing 233
Weather Service. See Meteorology.
Wells, blowing and sucking 242
Welsbach, Carl Auer von *327
Westinghouse air-spring *160
Westinghouse, George *377, 582
Weston, Edward *312
Wharve timbers, preservation *403
Wheels, grinding, safety appliances..*90
Wheels, grinding, making 270, *271
White, Sir William *499
Willow tree freak *271
Wiley, Harvey W. 282
Window shade, adjustable *450
Winds, trade 49
WIRELESS TELEGRAPHY.
—Amateur interference 399, 447, 516, 563
—Around the world 63
—Cipher code 238
—Eiffer time signals 437
—From a bicycle *91
—Government regulation, 261, 266, 282, 329, 531
—Guiding aviation in Sahara 325
—In Uraguay 375, 378
—International convention 531
—Navy stations around the world *360
—Shortcomings at sea 510
—Stations run by wind mills 175
—Time signals 65
—Tuning stations 371
—Uniform nomenclature 471
—Weather reports 49, 448
—Without antennas 128
—Wise eyes of Rain 205
Wood-borer destroyed by electricity..*403
Wood, most expensive 444
Woods, commercial 226
Workshop suggestions, 71, 111, 270, 237, 423, *567
Winds shake the earth 558
Wrench, spanner, adjustable *71
Wrench, universal *71
Wright, Wilbur 471, *518, 559
Wright aeroplane patents ..221, 287, 563

Z

Zapote tree as a source of chicle 428

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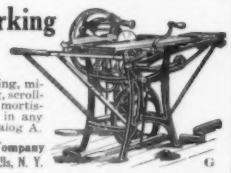

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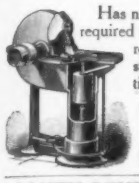

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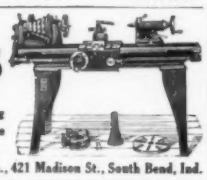

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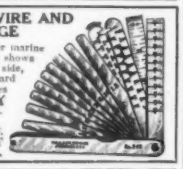

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The Heavens in July

(*Concluded from page 585.*)

behind him, and is invisible this month.

Mars is evening star in Leo, setting about 9 P. M. in the middle of the month, and appearing like a star of the second magnitude. During the latter part of the month he is within about 7 degrees of Mercury, but the two planets are not near enough to be said to be in conjunction.

Jupiter is in Scorpio, past opposition, coming to the meridian about 9 P. M., and is the finest object in the evening sky.

Saturn is morning star in Taurus, rising about 1:30 A. M. in the middle of the month.

Uranus is in opposition on the 24th. We have already told how to find him.

Neptune is in conjunction with the sun on the 16th, and is invisible.

The moon is in her last quarter on July 7th at 11 A. M.; new at 7 A. M. on the 14th; in her first quarter at 11 P. M. on the 20th, and full at 10 P. M. on the 28th. She is farthest away on the 1st and 28th, and nearest us on the 14th, which, being also the very day of new moon, will be marked by unusually high spring tides.

In her circuit around the heavens she passes by Uranus on the 1st, Saturn on the 10th, Venus and Neptune on the 14th, Mercury and Mars on the 16th, Jupiter on the 24th, and Uranus again on the 28th, without seeming to come very near any of them.

An International Exhibition of the Building Trades at Leipsic in 1913

IN 1913 an exhibition is to be held at Leipsic which will be devoted to the social life of man. The architect, the technician, the engineer and the tradesman will be able to obtain at this exhibition a survey of the entire realm of building. There will be eight sections. Section I will be devoted to the architecture of towns and settlements, underground and overground construction, interior decoration, homes and their decoration, architectural painting and sculpture, gardens and parks, cemeteries and their ornamentation, monuments and their care, conservation, etc.; section II will be devoted to the literature of the building trade, trade schools, office furniture; section III will be devoted to building material, their manufacture and use; section IV will include the machinery of building, such as tools and implements; section V will teach the visitor something about real estate transactions and will give him information on insurance, bookkeeping and the like; section VI will be devoted to hygiene in the home, factory and street as well as to the protection and welfare of the workingman; section VII will be devoted to gymnastics, games, etc.; section VIII will show how building material is tested.

Moving pictures will be used to show the processes employed in manufacturing articles for the home, the development of traffic and the state of architecture and the method of building in foreign countries.

The city of Leipsic will have a display of the evolution of municipal building in a separate pavilion.

The grounds will be larger even than those of the Dresden Hygiene Exposition of 1911.

Railway Building in German East Africa

ON February 26th of this year the central railway of German East Africa was completed as far as Tabora, which is about as far from the other end of the line, at Daressalam, as is Paris from Berlin. This important railway will be continued all the way across the colony to Kigoma, on Lake Tanganyika, and in the near future will doubtless be linked up with cross-continental railways now building from the Atlantic, and with the steamers on the Kongo River.

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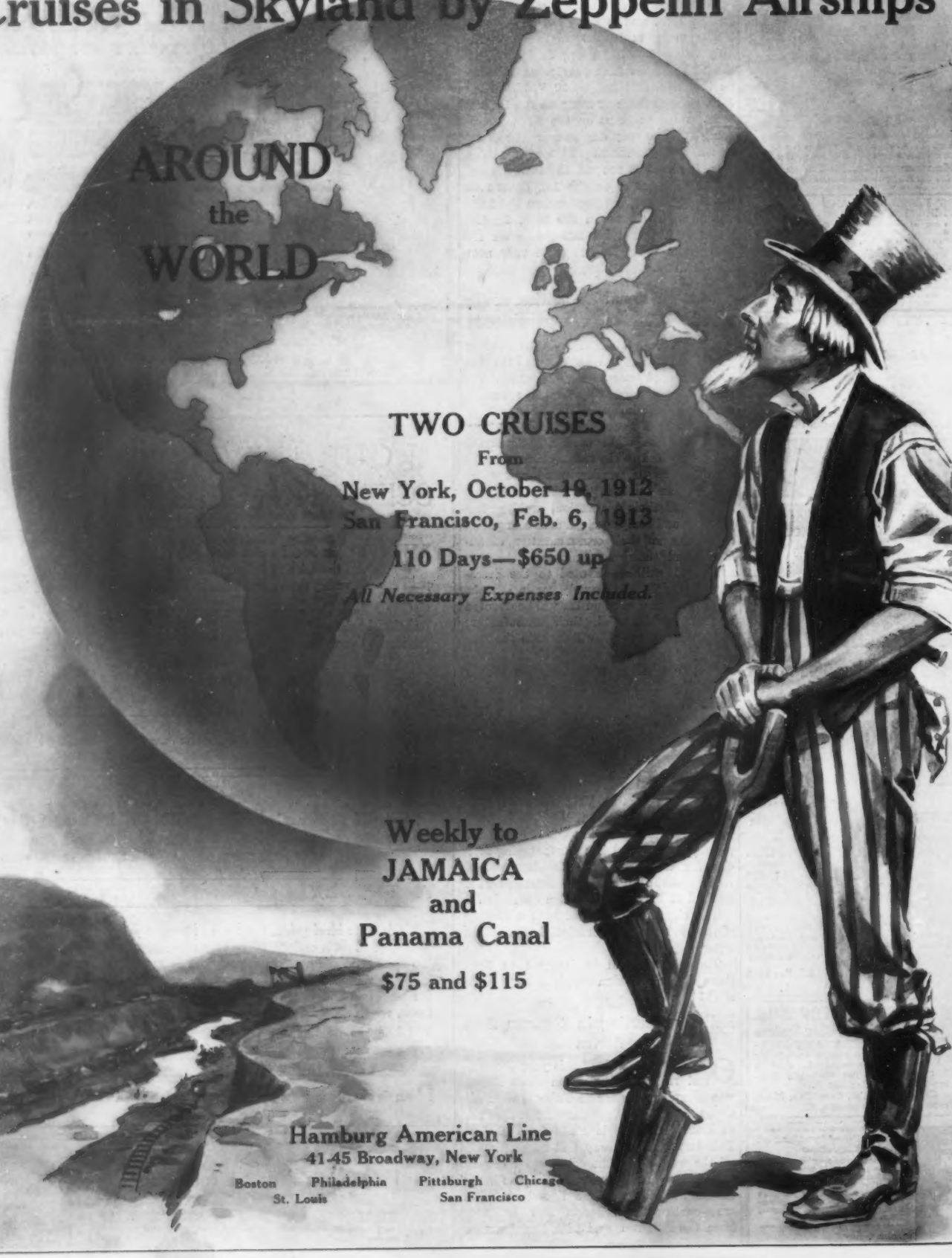

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